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The Commonwealth of Massachusetts

ANNUAL REPORT

OF THE

METROPOLITAN DISTRICT WATER SUPPLY COMMISSION

FOR THE

YEAR ENDING NOVEMBER 30, 1929

PUBLICATION OF THIS DOCUMENT APPROVED BY THE COMMISSION ON ADMINISTRATION AND FINANCE

1m-7-'31. No. 2963

REPORT OF THE METROPOLITAN DISTRICT WATER SUPPLY COMMISSION

To the Honorable the Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled.

The Metropolitan District Water Supply Commission, established under the provisions of Chapter 375 of the Acts of the year 1926, respectfully presents for the year ending November 30, 1929 its

FOURTH ANNUAL REPORT

I. Organization and Administration

There was no change in the personnel of the Commission during the year. Davis B. Keniston continued as chairman, and Charles M. Davenport and Joseph H. Soliday as associate commissioners. R. Nelson Molt continued as secretary.

The clerical force of the Commission's office at Boston remained the same throughout the year, and three special agents, under the direction of the Commission, continued to care for property acquired by the Commission in the Swift River and Ware River areas. Real estate purchasing agents and conveyancers and other experts were employed as needed. The engineering and clerical force of the engineering department averaged 125 employees during the year, with a maximum of 132 in August, 1929.

II. Engineering Department

Frank E. Winsor continued as chief engineer, with Karl R. Kennison as designing engineer and Walton H. Sears as mechanical engineer.

Three division engineers continued in charge of field divisions as follows: William W. Peabody, Wachusett-Coldbrook Tunnel Division; Richard R. Bradbury, Coldbrook-Swift Tunnel Division; and N. LeRoy Hammond, Swift River Reservoir Division.

The Commission reports with regret the death on June 1, 1929, of Walter Knowles, who as assistant engineer at the Framingham office, rendered efficient services in the construction of the Southern Sudbury Emergency Supply, and also later under Division Engineer N. LeRoy Hammond in the Swift River Reservoir Division.

X. H. Goodnough, Chief Engineer of the State Department of Public Health, and J. Waldo Smith, formerly Chief Engineer of the New York Board of Water Supply, continued as consulting engineers. Charles T. Main of Boston was employed from time to time as consulting engineer on mill and water power damages, and Doctor Charles P. Berkey of Columbia University continued as geologist. Other consultants were employed from time to time as needed.

III. Offices

The office of the Commission and of the Chief Engineer continued in the Boston Five Cents Savings Bank Building at 24 School Street, Boston. The three division offices for the Wachusett-Coldbrook Tunnel, the Coldbrook-Swift Tunnel and the Swift River Reservoir Divisions continued at Holden Center, Hardwick Center and Enfield, respectively. The laboratory for water analysis, established in 1928, continued at Springfield.

IV. Real Estate

During the year 226 new applications to the Commission were added to the 1,210 previously received from the owners of real estate located in and near the Swift River Valley, making a total to date of 1,436 applications, seeking to sell to the Commission a total of 58,989 acres. Of this total acreage the Commission has concluded the purchase of, or has under option, a total of 38,922 acres. Further details appear in the attached tables.

Some land was acquired also along the line of the Wachusett-Coldbrook Tunnel and in the Ware River watershed above the Intake Works at Coldbrook for sanitary protection.

The Commission continued, through duly appointed agents, the direction of the town government of the town of Prescott, as provided by Chapter 340 of the Acts of 1928. A financial statement for the town is included in the Commission's report to the Commissioner of Corporations and Taxation.

V. Progress

(*a*) *General.* — The United States War Department, on May 17, 1929, advised the Commission of the Department's decision, in response to the Commission's application for diversion of the waters of the Swift River, in accordance with the provisions of Chapter 321 of the Acts of 1927, that,

"From the studies of past records it appears there will be no substantial alteration or modification of the condition or navigable capacity of the channel of the navigable portion of the Connecticut River if the flow of water from the Swift River as provided in the terms of Chapter 321 of the Acts of 1927 (Massachusetts) be augmented during the critical period from June 1 to November 30, both inclusive, so that the measured rate of discharge on the Swift River shall be 70 cubic feet per second on such days as the U. S. Geological Survey gauge at Sunderland, Massachusetts, indicates the discharge of the Connecticut River at that point to be less than 4,900 cubic feet per second and more than 4,650 cubic feet per second, and shall be further augmented so that the measured rate of discharge past the impounding dam on the Swift River shall be 110 cubic feet per second on such days as the Geological Survey gauge at Sunderland, Massachusetts, indicates the discharge of the Connecticut River at that point to be 4,650 cubic feet per second or less."

The bill in Equity filed by the State of Connecticut in the United States Supreme Court against the Commonwealth of Massachusetts, objecting to the diversions from the Ware River and Swift River, authorized by the Massachusetts Legislature is still pending.

(*b*) *Southern Sudbury Emergency Supply.* — The Commission has consummated the settlement of practically all outstanding claims for taking of real estate and diversion damages on the Southern Sudbury Emergency Supply.

(*c*) *Ware River Supply.* — During the past year work was continued by the West Construction Co., Assignee, under two contracts, numbered 14 and 17, for the construction of the Wachusett-Coldbrook Tunnel, and approximately 9.0 miles of tunnel were excavated. The Outlet Works of the Wachusett-Coldbrook Tunnel to the upper waters of the Wachusett Reservoir at Shaft No. 1, West Boylston, were partly completed. A contract for the construction of a low diversion dam across the Ware River at the White Valley mill pond in Barre, for diverting the waters, permitted to be diverted, of the Ware River into Shaft No. 8, and for the construction of the substructure of the Intake Works was awarded to J. W. Bishop & Co., of Worcester, Mass. Work was in progress under this contract.

(*d*) *Swift River Supply.* — Real estate and topographical surveys were continued during the year. Work was continued on the census of burials in cemeteries, together with records of inscriptions on headstones and monuments. Upon request some bodies were removed from the reservoir area and interred in other cemeteries.

VI. Financial

The Commission appends hereto a statement of its expenditures and disbursments for the fiscal year, and from the date of its appointment.

VII. Other Reports

The report of the Chief Engineer is herewith presented. It includes a summary of the information of geological interest, in accordance with the requirements of Section 2 of Chapter 321 of the Acts of 1927.

Respectfully submitted,

DAVIS B. KENISTON, *Chairman*
CHARLES M. DAVENPORT, *Associate Commissioner*
JOSEPH H. SOLIDAY, *Associate Commissioner*
Metropolitan District Water Supply Commission

24 School Street, Boston, Massachusetts,
December 27, 1929.

REPORT OF THE CHIEF ENGINEER

To the Metropolitan District Water Supply Commission.

GENTLEMEN: — The following is a report of the engineering department for the year ending November 30, 1929.

ORGANIZATION

In numbers the engineering organization has not materially changed during the year.

Karl R. Kennison, Designing Engineer, continued in charge of all studies in connection with the general plan of the work and the design of structures, preparation of contract specifications, contract and working drawings. Charles L. Coburn and Stanley M. Dore were promoted to Assistant Designing Engineers.

Walton H. Sears, Mechanical Engineer, continued in charge of the collection of data in connection with mill and water power damages. He has assisted in the design of work of a mechanical engineering nature and in the preparation of contract specifications.

Three division engineers continued in charge of field divisions as follows: William W. Peabody, Wachusett-Coldbrook Tunnel Division; Richard R. Bradbury, Coldbrook-Swift Tunnel Division; N. LeRoy Hammond, Swift River Reservoir Division.

Walter H. Junkins, Chemist, continued in charge of the Springfield Laboratory.

X. H. Goodnough, Chief Engineer of the State Department of Public Health, and J. Waldo Smith, formerly Chief Engineer of the New York Board of Water Supply, continued as Consulting Engineers. Charles T. Main, consulting engineer of Boston, has advised on mill and water power damages. Dr. Charles P. Berkey of Columbia University has advised on geological matters. Other experts were employed from time to time as required.

The employees under the direction of the Chief Engineer at the end of the year and of the preceding year were as follows:

PERSONNEL OF ENGINEERING DEPARTMENT

Classification	Nov. 30, 1928	Nov. 30, 1929
HEADQUARTERS OFFICE, CHIEF ENGINEER AND DESIGNING DIVISION:		
Chief Engineer	1	1
Designing Engineer	1	1
Mechanical Engineer	1	1
Assistant Designing Engineers	–	2
Assistant Engineers	11	9
Draftsmen	9	7
Instrumentmen	2	1
Senior Stenographer	1	1
Stenographers	3	3
Clerks	2	2
File Clerk	1	2
Office Boy	1	1
	33	31
HOLDEN OFFICE, WACHUSETT-COLDBROOK TUNNEL DIVISION:		
Division Engineer	1	1
Assistant Engineers	5	8
Draftsmen	2	2
Instrumentmen	5	3
Rodmen	5	3
Axemen	4	7
Inspectors	8	9
Stenographer	1	1
	31	34
HARDWICK OFFICE, COLDBROOK-SWIFT TUNNEL DIVISION:		
Division Engineer	1	1
Assistant Engineers	5	4
Draftsmen	1	2
Instrumentmen	1	4
Rodmen	8	4
Axmen	4	4
Inspectors	1	3
Gage Tender	–	1
Stenographer	–	1
	21	24

Classification	Nov. 30, 1928	Nov. 30, 1929
Enfield Office, Swift River Reservoir Division:		
Division Engineer	1	1
Assistant Engineers	9	6
Draftsmen	3	1
Instrumentmen	7	6
Rodmen	11	7
Axemen	7	4
Inspector	1	–
Caretaker	–	1
Stenographer	–	1
	39	27
Springfield Laboratory:		
Chemist	1	1
Assistant Engineer	1	1
Assistant Chemist	1	1
Instrumentman	1	1
Boatman	1	1
Clerk	1	1
	6	6
Total Engineering Force	130	122

The maximum force during the year was 132, during the weeks ending August 24 and 31. The minimum force was 118 during the week ending November 2. The average force for the year was 125.

Offices

The office of the Chief Engineer and Designing Division was continued in the Boston Five Cents Savings Bank Building at 24 School Street, Boston. The field office of the Wachusett-Coldbrook Tunnel Division was continued at Washburn Hall, Holden Center. The field office of the Coldbrook-Swift Tunnel Division was continued in the brick building formerly used as a school at Hardwick Center. The field office of the Swift River Reservoir Division was continued in Enfield in the Felton Block until December 27, 1928, when the office was moved to property of the Commission formerly known as Frances W. Chandler House on Quabbin Road in Enfield. Necessary changes were made in this house and a new three-story fireproof vault was built. The laboratory for water analysis was continued in the Markarian Building, at 175 State Street, Springfield.

Headquarters Office

Summary of the Year's Work

Application for Diversion from Swift River. — Studies of the effect of the proposed diversion for the Metropolitan District of waters from the Ware and Swift Rivers upon the flow of the Connecticut River were continued. The War Department, under date of May 17, 1929, replied to the Commission's application to divert the waters of the Swift River as authorized by Chapter 321, Acts of 1927, by finding that "there will be no substantial alteration or modification of the condition or navigable capacity of the channel of the navigable portion of the Connecticut River if the flow of water from the Swift River as provided in the terms of Chapter 321, of the Acts of 1927 (Massachusetts), be augmented during the critical period from June 1, to November 30, both inclusive, so that the measured rate of discharge on the Swift River shall be 70 cubic feet per second on such days as the United States Geological Survey gage at Sunderland, Massachusetts, indicates the discharge of the Connecticut River at that point to be less than 4,900 cubic feet per second and more than 4,650 cubic feet per second and shall be further augmented so that the measured rate of discharge past the impounding dam on the Swift River shall be 110 cubic feet per second on such days as the Geological Survey gage at Sunderland, Massachusetts, indicates the discharge on the Connecticut River at that point to be 4,650 cubic feet per second or less."

Real Estate. — In the Swift River Reservoir area, 8,870 acres were offered for sale by their owners this year, making a total so offered to date of 58,989 acres. Reports and recommendations were submitted to the Commission with respect

to purchasing the same. Preliminary studies were continued of highway and cemetery locations.

One taking plan covering 16 parcels of land in the town of Barre for the Coldbrook-Swift Tunnel was prepared and filed during the year.

Contracts and Specifications. — Working drawings for Contracts 14 and 17 for constructing the Wachusett-Coldbrook Tunnel were prepared and issued.

Contract 18, for which specifications and plans were completed early in the year for furnishing cast-iron plates for lining the Ware River intake shaft and other castings required for the intake control works, was executed January 8.

Plans and specifications were completed for Contract 19, for constructing a low diversion dam and the substructure of the building for the Ware River Intake Works at Shaft 8, of the Wachusett-Coldbrook Tunnel in the town of Barre. The contract was executed on July 23. Subsequently working drawings were prepared covering details of the work of construction.

Plans and specifications were prepared for Contract 22 for furnishing and installing an Unwatering Pump in Shaft 1 of the Wachusett-Coldbrook Tunnel in the town of West Boylston. The contract was executed on November 12.

Plans and specifications were prepared for Contract 23 for making borings at the proposed sites of the main dam and of the dike of the Swift River Reservoir, and at the west portal of the proposed Coldbrook-Swift Tunnel. This contract was executed on November 5.

Inspection and Tests. — E. L. Conwell and Company of Philadelphia, Pa., continued the testing of cement. Concrete cylinders and mortar cubes were tested for compressive strength and steel reinforcement bars were tested at the laboratory of the Worcester Polytechnic Institute. The inspection of the castings made under Contract 18 was made by the engineering force.

William R. Conard (and predecessor, Conard & Buzby) of Burlington, New Jersey, has made mill inspection and tests of sluice gates and control valves and mechanism required for the Ware River Intake Works at Shaft 8, and of steel linings, valves and other metal work for the Outlet Works at Shaft 1 of the Wachusett-Coldbrook Tunnel.

Hydrographic Data. — The gaging station on the Ware River at Coldbrook was continued in cooperation with the United States Geological Survey. Additional discharge measurements were made from time to time to define the rating curve more exactly, particularly in the winter during the ice conditions.

The gaging station at the United Electric Light Company plant at Bircham Bend was continued in cooperation with that company and also with the United States Geological Survey. Additional discharge measurements were made during the year to define the discharge curves of the water wheels and the dam.

The gaging station rated in 1927 at the water power plant of the Boston Duck Mills of the Otis Company at Bondsville was continued.

The gaging station on the Connecticut River at Thompsonville, Connecticut, located at the "Enfield Dam," so called, was continued in cooperation with the United States Geological Survey. Additional measurements were made to better define the rating curves of both the dam and canal.

In connection with the sanitary survey of the Ware, Swift and Chicopee Rivers, various points on these rivers were established as temporary stream gaging stations and observations of flow taken during the periods of sampling.

Design of Structures

Shaft 1. Tunnel Unwatering Pump. — Studies were made of equipment for unwatering the Wachusett-Coldbrook Tunnel. A length of about 18,000 feet at the east end of the tunnel is depressed below the hydraulic grade, to insure a sufficient cover of sound rock. On this account approximately 28 million gallons of water cannot be drained by gravity into the Wachusett Reservoir when it is full to its spillway level, and approximately 20 million gallons will still remain after it is drawn down below the tunnel outlet. Unwatering equipment will be required to insure the removal within the required time of the water which cannot be drained by gravity.

The pump will be a single stage centrifugal pump delivering 20 mil. gals. daily against a total head of 205 ft., at a speed of 1,170 rev. per min., driven by a 900

H.P. 2,200-volt motor of the squirrel cage induction type. A travelling crane to be installed later in the superstructure will be designed to lift the motor out of the shaft for storage at the upper level if desired. Contract 22 will include also an air blower to supply 6,000 cu. ft. per min. to the bottom of the shaft.

To maintain the pump shaft itself in an unwatered condition, a sump pump of the deep-well type, with a capacity of 80 gals. per min., has been purchased and will be installed as soon as the shaft lining under Contract 14 is completed.

Designs were made for a special 20-inch solid bronze valve on the inlet of the unwatering pump, intended for operation from either the bottom or top of the pump shaft. This valve was purchased, and will be installed under Contract 14.

Tunnel Bulkhead. — A steel bulkhead was designed to be built into the tunnel west of the Ware River Intake at Shaft 8. This bulkhead will have gates so hinged as to allow a flow in the easterly direction only, and will serve a double purpose: First, to allow construction to proceed on the future extension of the proposed tunnel westerly to the Swift River Reservoir without interference with the use of the Wachusett-Coldbrook Tunnel for diverting flows of the Ware River into the Wachusett Reservoir; second, to allow if later required a preliminary diversion of water from the Swift River into the Wachusett Reservoir and at the same time prevent Ware River diversions from flowing westerly through the proposed tunnel extension into the Swift River Reservoir before the latter is completed and ready for storage. This bulkhead will be entirely removed after the Swift River Reservoir is completed.

Shaft 8. Ware River Intake Works. — Further studies were made of the works required for diverting the Ware River into the Wachusett-Coldbrook Tunnel at Shaft 8, particularly of details of control valves and equipment. One 72-inch and three 60-inch Dow disc valves with automatic operating devices will be installed under Contract 19.

Each valve will be set with its disc revolving on a horizontal axis and will be supported on a base casting which in turn will be set directly over a nozzle casting of irregular shape, designed to direct the discharge tangentially against the upper row of shaft lining plates. The cast iron shaft lining plates, 300 in number, are designed to be erected in 50 rings, 18′-8″ inside diameter and 3′-8⅜″ high, each ring having six plates flanged and bolted together. The plates are cast with interlocking lugs and are designed to fit together accurately without machine work. The only projection on the inside is a helical ring which serves as a guide for the water and which consists of one diagonal vein from corner to corner of each plate projecting from six to ten inches and serving also to stiffen the casting.

The diversion dam has been designed as a low spillway consisting mainly of a thin circular arch with a radius of 52.5 feet and with a crest at elevation 657.0 above Boston City Base. The length of the spillway will be 174 feet at this elevation including 34 feet along the top of the abutment sections. The circular spillway between the abutment sections is designed to discharge into a pool about elevation 640 which is slightly higher than the level of the river a little downstream and the more massive abutment sections are stepped on the downstream face and furnish additional spillway length discharging directly into the river below the pool. The abutment sections of the spillway in turn abut against retaining walls on either bank which extend to a height ten feet above the spillway level. On the south bank an earth dike with its top at elevation 667 extends into the hillside, as far as the Boston & Albany Railroad track and on the north bank the dam abuts directly against the intake building substructure. The siphon spillways which discharge into the tunnel are designed with crests at elevation 656 or one foot lower than the flood spillway of the diversion dam. All exposed concrete above the water level is designed with a facing of granite.

Springfield Laboratory

At the laboratory in Springfield the analysis of water samples taken in the Connecticut River and its tributaries was continued. Studies were also made of quality of water in the Ware, Swift, and Chicopee rivers.

Wachusett-Coldbrook Tunnel Division — Holden Office

The Wachusett-Coldbrook Tunnel Division continued in charge of the construction of the Wachusett-Coldbrook Tunnel, with the exception of Shaft 8.

The division office was continued at Holden Center and six field offices at Shafts 1, 2, 4, 5, 6, and 7.

Office Work

Property surveys were computed and mapped, topographical notes reduced and plotted; tunnel sections were plotted and excavation volumes computed therefrom; semi-monthly estimates were prepared for Contracts 14 and 17, and monthly estimates for Contract 10.

Geological field notes and specimens were prepared for a permanent geological record.

Preliminary studies were made of the character of materials available for concrete aggregates from the tunnel and shaft excavations. Records were kept of the cost of the different units of equipment used at each of the shafts, as provided in Contracts 14 and 17.

Field Work

Property surveys were made in the town of Rutland, and in the vicinity of Shaft 2 in the town of Holden. A line of levels, 22 miles in length, was run in connection with studies of sewage disposal from institutions in Rutland. A study of the sanitary conditions of recreation camps in the Ware River drainage area and also of several ponds in that watershed was made.

Lines and grades were given for construction work on the Wachusett-Coldbrook Tunnel.

Surveys for the location of property bounds were made and such bounds set as required.

Photographs of the construction work and of rock formations of geological interest in the tunnel were taken.

Weekly observations of water color samples were made at a number of stations along the Ware River and its tributaries above the intake works.

The State Department of Public Health with cooperation of this division continued the analysis of samples of drinking water used in the different contractors' camps and of the effluent from the sewage disposal plants at various institutions in Rutland and also made seasonal investigations of mosquitoes at the different construction camp sites with particular reference to the prevention of malaria.

Progress of Contracts

Contract 10. — Contract 10 with the New England Power Company, for constructing, maintaining and operating a 22,000-volt transmission line along the Wachusett-Coldbrook Tunnel line, was in force throughout the year. The cost of operation and maintenance for the twelve months ending October 1, was $8,496.96.

Electric power was purchased from this company by the contractors on Contracts 14 and 17. The total power furnished during the year was 15,865,400 KWH including line and transformer losses. This total after line losses (but including transformer losses) was distributed to the different shafts as follows:

	KWH
Shaft 1	320,271
Shaft 2	2,970,628
Shaft 3	16,734
Shaft 4	2,956,800
Shaft 5	2,298,454
Shaft 6	1,641,098
Shaft 7	2,652,154
Shaft 8	2,729,464
Total	15,585,603

During a very severe electrical disturbance on June 15, for a period of about five hours, no power was available, but with this exception power was furnished throughout the year with only minor interruptions.

Wachusett-Coldbrook Tunnel. — Work on the tunnel was prosecuted throughout the year under Contracts 14 and 17 by the West Construction Company, who continued to lease from the Commission various buildings at West Rutland as general headquarters. The contractor continued to employ local physicians who made weekly reports on the health of the contractors' employees and on the sanitary condition at each of the contractors' camps.

Contract 14. — Contract 14 is for the construction of the east portion of the Wachusett-Coldbrook Tunnel through West Boylston, Holden and Rutland, and extends from Shaft 1 at the upper end of the Wachusett Reservoir near Oakdale to midway between Shafts 4 and 5 in Rutland. At the end of the year about 51% of the value of the work had been completed. This included the completion of Shaft 1 excavation and preliminary concrete lining, and 515 feet of concrete lining of the tunnel adjacent to Shaft 1. During the year about 75% of the steel lining for the pump and waterway shafts at Shaft 1 was placed and concrete was placed outside the steel linings for a distance of 184 feet above the bottom of the pump shaft. The masonry was completed in the walls of the outlet channel, concrete piers, and curtain wall.

During the year a total length of 19,333 feet of tunnel was excavated, making a total to date of 21,981 feet under this contract and a total length under this and previous contracts of 25,791 feet. About 7,911 feet remained to be excavated. The value of work included in contract estimates during the year was $1,563,900.64, or a total to November 15, the date of the latest estimate, of $1,832,400.79, of which 90% has been approved for payment.

Shaft 1, and Outlet Channel. — At the beginning of the year excavation had reached a total depth of 158.5 feet at elevation 247.0 and on January 1, was completed to a depth of 222.8 feet at elevation 182.67, the bottom of the pump shaft. The preliminary concrete lining had previously been placed down to elevation 273.0 and on December 16, the last section of this lining was placed, the bottom being at elevation 217.0. For the remaining depth of shaft the rock continued to be of excellent character and carried no additional water. Tunnel excavation toward Shaft 2 began on December 22, and continued until June 5, when excavation was suspended. About 511 feet of excavation for the circular type, adjacent to the shaft, 15 feet for a transition section and 310 feet of the horseshoe type, making a total of 836 feet was completed. Concrete lining of the circular type and transition section began on June 25, and was completed on August 15.

The excavation of the outlet channel waterway was completed during the week ending February 1, and the construction of the channel walls was completed during the week ending March 9. The stone for the ashlar masonry facing was obtained from quarries in Fitchburg, Mass.

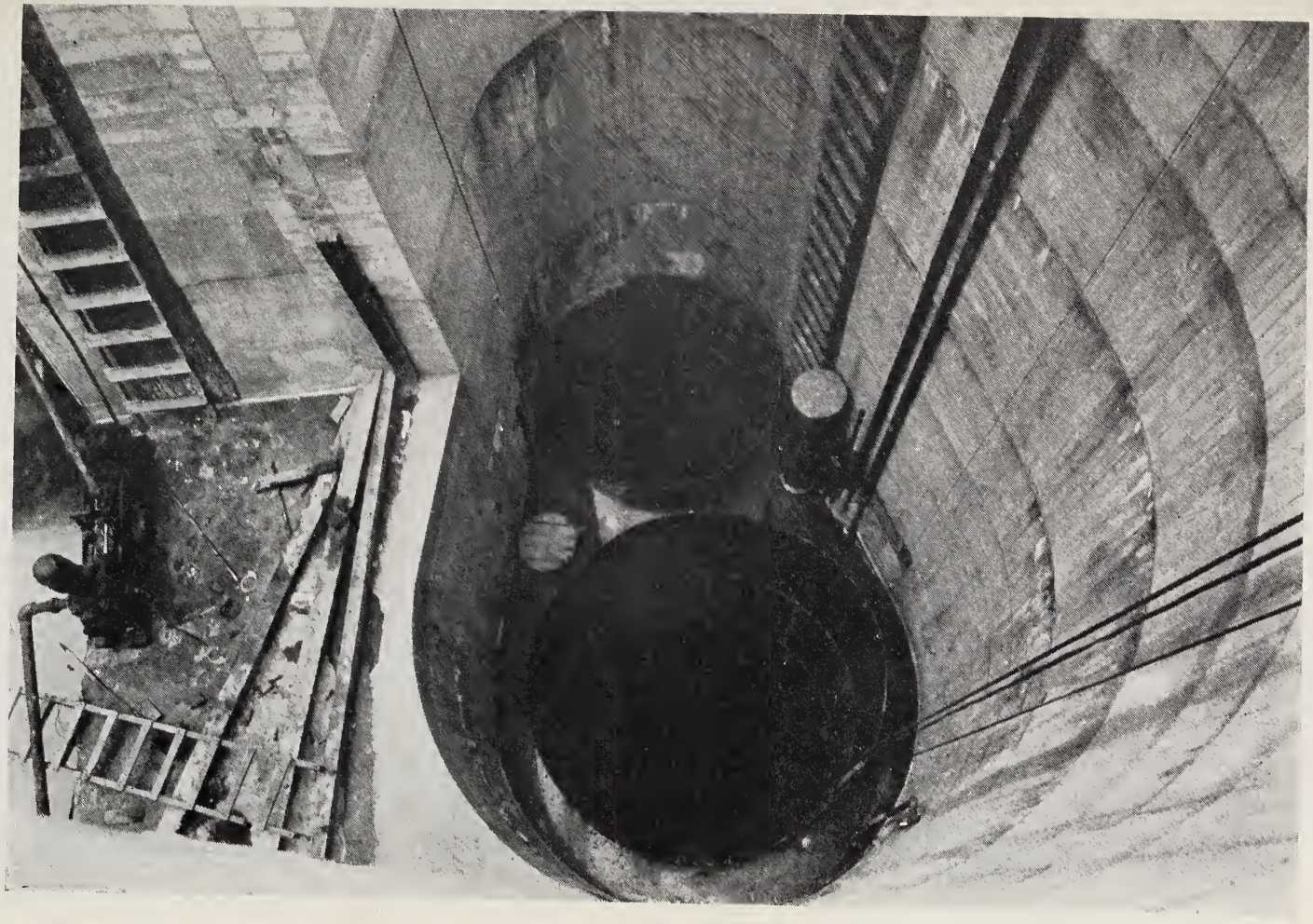
The first section of steel lining for the pump shaft was received at Shaft 1 on August 27. On September 21, the plates for the bottom section of the enlarged pump chamber were placed and bolted into position, and later were riveted and caulked. The cast iron pump discharge and ventilation pipe lines were carried up with the steel lining and embedded in the concrete partition between the pump shaft and waterway shaft. At a point about 127 feet above the bottom of the pump shaft, the steel lining for the waterway shaft begins. Sections of this lining were delivered unassembled at the shaft, in average lengths of about 7 feet. From the lower end of the steel lining of the waterway shaft both this lining and that of the pump shaft were brought up as nearly as possible at the same level, and the concrete around the steel was brought up as before. The average weekly progress for construction of the lower 127 feet of pump shaft was about 18.1 feet. The average weekly progress for construction of the upper shaft and waterway adjacent to it, including steel lining for both shafts, placing concrete on the outside of the two shafts and also placing pump discharge and ventilating pipes was about 18.8 feet.

The contractor's force averaged 35 men throughout the year.

The following items of plant equipment were added during the year: One air blower rated at 3,600 cu. ft. of free air per min. and driven by a 20 H.P. motor; a welding outfit and carpenter shop equipment.

Shaft 2. — Excavation at this shaft has progressed as follows:

Location	Total Excavation under a previous contract	Total Excavation under Contract 14		Total Excavation to Nov. 30, 1929
		to Nov. 30, 1928	Year ending Nov. 30, 1929	
East Heading	868 ft.	742 ft.	4,360 ft.	5,970 ft.
West Heading	903 ft.	1,018 ft.	5,254 ft.	7,175 ft.
Total	1,771 ft.	1,760 ft.	9,614 ft.	13,145 ft.



CONTRACT 14. — Steel Linings in Tunnel Outlet, Shaft 1. The larger opening is the waterway, and the smaller opening the pump shaft.

The full heading method of excavation was continued throughout the year with no material change. Drill carriages such as were previously used at Shaft 4 were installed. These carriages allowed five drills to be used at once and enabled a crew to drill one heading completely while another crew were mucking the opposite heading. After the introduction of the carriages three drill shifts and three mucking shifts were employed and continued for the remainder of the year.

The average weekly progress on tunnel excavation during the period from December 1, 1928, to February 23, was easterly 32.1 feet and westerly 104.0 feet, and during the period from February 23, to November 30, was easterly 99.4 feet and westerly 100.1 feet. The maximum progress was in the week ending October 19, when 110.0 feet were excavated in the east section and 117.0 feet in the west section.

The contractor's force averaged 119 men throughout the year.

There has been no material change in plant items during the year. One additional five-ton storage battery locomotive was transferred from Shaft 4. In all, 15 pumps were used in connection with tunnel construction. The largest has a rated capacity of 700 gals. per min. under a 100 ft. head, driven by a 30 H.P. motor. The combined compressor capacity was 1,926 cu. ft. per min.

Shaft 3. — Shaft 3 was kept unwatered until December 22, 1928, when the contractor dismantled the pumping plant. It is expected that the remaining tunnel between Shafts 2 and 4 can be completed in the time specified without the resumption of further excavation from this shaft. The distance excavated (under a previous contract) is 630 feet easterly and 566 feet westerly, a total of 1,196 feet.

Shaft 4. — Excavation at this shaft has progressed as follows:

Location	Total Excavation under a previous contract	Total Excavation under Contract 14		Total Excavation to Nov. 30, 1929
		to Nov. 30, 1928	Year Ending Nov. 30, 1929	
East Heading	442 ft.	529 ft.	4,610 ft.	5,581 ft.
West Heading	401 ft.	359 ft.	4,273 ft.	5,033 ft.
Total	843 ft.	888 ft.	8,883 ft.	10,614 ft.

At the beginning of the year tunnel excavations were carried on by the top heading and bench method. In this method of excavation four drilling shifts were used and three mucking shifts which alternated between the two headings. Drill carriages of the type used subsequently at the heading in Shaft 2 were installed in the west and east headings respectively. After the installation of these carriages, tunnel driving operations continued using the full heading method and three shifts of drilling and mucking, the procedure being similar to that described for Shaft 2.

In the east heading, about 2,100 feet from the shaft, timbers for temporary roof support were erected for a distance of 38 feet.

The rock in portions of the roof of the west heading beginning at a point about 2,400 feet from the shaft, while sound when first exposed, loosened under exposure to the air and the contractor was permitted to cover about 2,615 linear feet of tunnel roof with cement mortar, or a "gunite," using a cement gun operated with compressed air. The mortar was applied in two or three coats, each with a thickness of about ¾ inch.

The average weekly progress on tunnel excavation was easterly 88.7 feet and westerly 82.2 feet, the maximum progress being in the week ending June 29, when 131.0 feet were excavated in the east section and 106.5 feet in the west section.

The contractor's force averaged 125 men.

There has been no material change in plant items during the year. One 3½ ton gasoline locomotive was transferred from Shaft 2. In all eleven pumps were used in connection with tunnel construction. The largest has a rated capacity of 700 gals. per min. under a 100 ft. head, driven by a 30 H.P. motor. The combined compressor capacity was 1,926 cu. ft. per min.

The total work done and materials furnished to date under the principal items of Contract 14 were as follows:

	Shaft 1	Shaft 2	Shaft 4
Earth excavation for shafts (cu. yds.)	1,108	–	–
Rock excavation in shafts and in tunnel within 50′ of shafts (cu. yds.)	3,175	–	–
Excavation in tunnel, except within 50′ of shafts (cu. yds.)	5,935	77,033	67,138
Shaft and tunnel drainage (lin. ft.)	1,035	7,904	6,752
Forms for preliminary concrete lining, shaft 1 (lin. ft.)	188	–	–
Forms for concrete lining in tunnel (lin. ft.)	526	–	–
Concrete masonry in shafts (cu. yds.)	1,548	–	–
Concrete masonry in tunnel (cu. yds.)	1,595	–	–
Concrete masonry not in shafts and tunnel (cu. yds.)	2,339	27	17
Temporary timbering in tunnel (M ft. B.M.)	–	–	4.25
Portland Cement (bbls.)	9,612	35	586
Earth excavation except for shafts (cu. yds.)	10,480	2,260	5,616
Rock excavation except in shafts or tunnel (cu. yds.)	796	35	771
Refilling and embankment (cu. yds.)	8,110	6,220	4,193
Miscellaneous cast iron, wrought iron and steel (lbs.)	265,889	2,879	331
The Contractor's total force averaged (men)	35	119	125

Contract 17. — Contract 17 is for the construction of the west portion of the Wachusett-Coldbrook Tunnel through Rutland, Oakham and Barre, and extends westerly from the work covered by Contract 14, the work being prosecuted from Shafts 5, 6, 7 and 8.

The top heading and bench method of excavation was continued at all shafts throughout the year, but the method of handling the muck has changed from time to time. At the end of the year about 63% of the value of the work had been completed.

During the year a total length of 28,109 feet of tunnel was excavated, making a total to date of 34,558 feet, under Contract 17, or a total length under this and previous contracts of 38,987 feet. About 1,569 feet remained to be excavated east of Shaft 8 and 4,355 feet have been excavated west of Shaft 8.

The value of work included in contract estimates during the year was $2,166,-437.99, or a total to November 15, the date of the latest estimate, of $2,658,041.63, of which 90% has been approved for payment.

Shaft 5. — Excavation at this shaft has progressed as follows:

Location	Total Excavation under a previous contract	Total Excavation under Contract 17		Total Excavation to Nov. 30, 1929
		to Nov. 30, 1928	Year Ending Nov. 30, 1929	
East Heading	670 ft.	956 ft.	4,193 ft.	5,819 ft.
West Heading	697 ft.	1,000 ft.	4,270 ft.	5,967 ft.
Total	1,367 ft.	1,956 ft.	8,463 ft.	11,786 ft.

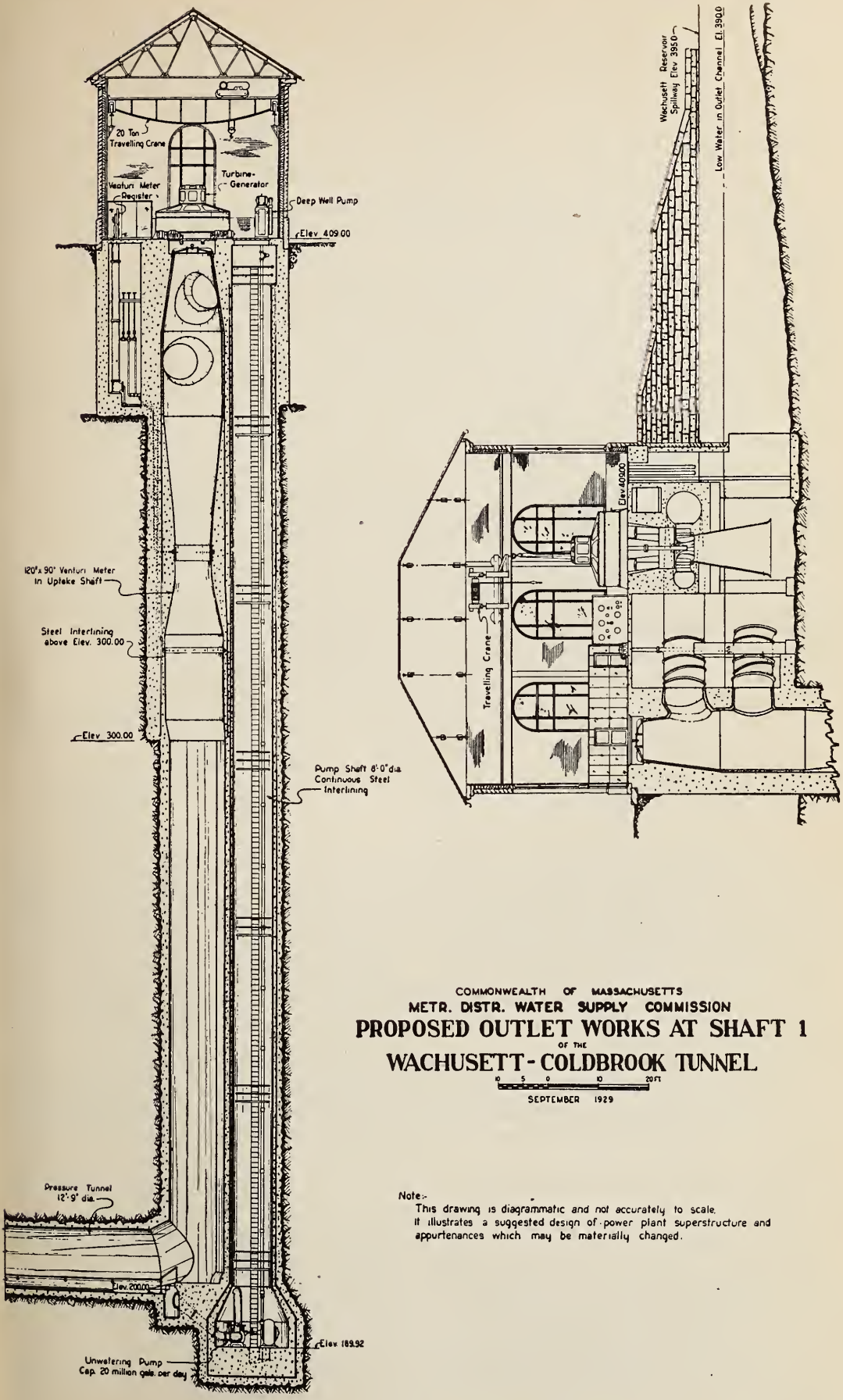
The rock from this shaft has continued to be of good quality for tunnelling, except that the rock in the tunnel roof near the east heading appears quite similar to that in the west end of the tunnel at Shaft 4. In this section frequent scaling was necessary, but no gunite or other support has been placed.

On November 15, excavation had reached the easterly limit of Contract 17, a point half way between Shafts 4 and 5, and excavation in this heading was suspended and final trimming and grading the tunnel was begun. This work consisted of grading the invert to required lines and trimming the tunnel at those points where the rock had broken inside of the lines specified. The average weekly progress on tunnel excavation easterly was 83.9 feet and westerly 82.1 feet, the maximum progress being in the week ending December 8, when 90.5 feet were excavated in the east section and 101.5 feet in the west section.

The contractor's force averaged 90 men per day, two shifts being employed.

There was no material change in the plant items during the year. In all five pumps were used in connection with tunnel construction. The largest has a rated capacity of 300 gals. per min. under a 670 ft. head, driven by a 100 H. P.motor. The addition of an air compressor driven by a 150 H.P. motor made the combined compressor capacity 2,341 cu. ft. per min.

CONTRACT 17. — After holing through between Shafts 6 and 7.



Profile of Proposed Outlet Works at Shaft 1.

Shaft 6. — Excavation at this shaft has progressed as follows:

Location	Total Excavation under a previous contract	Total Excavation under Contract 17 to Nov. 30, 1928	Total Excavation under Contract 17 Year Ending Nov. 30, 1929	Total Excavation to Nov. 30, 1929
East Heading	671 ft.	1,060 ft.	3,042 ft.	4,773 ft.
West Heading	669 ft.	1,117 ft.	2,946 ft.	4,732 ft.
Total	1,340 ft.	2,177 ft.	5,988 ft.	9,505 ft.

Hand methods of mucking were substituted for mechanical methods in the west heading on March 24, and hand methods were used throughout the year in the east heading.

The rock continued of good quality for tunnelling, no timber supports of any nature being required. Late in July progress was retarded by water encountered in the east heading necessitating a rearrangement of pumping equipment. Tunnel driving was discontinued in the west heading on September 2, and in the east heading on September 22, leaving the remaining adjoining unexcavated portions to be driven from Shafts 7 and 5 respectively, and final trimming and grading of the tunnel was begun preparatory to placing concrete lining. At the end of the year approximately 6,840 feet had been prepared ready for placing of concrete.

The average weekly progress on tunnel excavation easterly was 72.4 feet and westerly 75.0 feet, the maximum progress being in the week ending June 29, when 93.0 feet were excavated in the east section and 94.0 feet in the west section.

The contractor's force to September 21, averaged 97 men and for the year 84 men per day, two shifts being employed.

There has been no material change in plant items during the year. In all seven pumps were used in connection with tunnel construction. The largest has a rated capacity of 300 gals. per min. under a 670 ft. head driven by a 100 H.P. motor. The combined compressor capacity was 1,511 cu. ft. per min.

Shaft 7. — Excavation at this shaft has progressed as follows:

Location	Total Excavation under a previous contract	Total Excavation under Contract 17 to Nov. 30, 1928	Total Excavation under Contract 17 Year Ending Nov. 30, 1929	Total Excavation to Nov. 30, 1929
East Heading	861 ft.	908 ft.	2,731 ft.	4,500 ft.
West Heading	861 ft.	1,130 ft.	3,007 ft.	4,998 ft.
Total	1,722 ft.	2,038 ft.	5,738 ft.	9,498 ft.

On January 15, a change was made in the drilling and mucking schedule; from this time on the drilling and shooting of both headings being done during the night shift and mucking during the day shift. Previous to this, the schedule of operation was similar to that used at Shafts 5 and 6. Each shift was depended upon to complete its schedule of required work. A slight increase in depth of holes in the heading to 10 feet resulted in as large a volume of muck as could be excavated in one full day shift without any overlapping. Mechanical mucking was continued throughout the year.

On October 25, at 3.00 A.M., the east heading was holed through to the west heading of Shaft 6 at station 574+52.67, the grade checking to 0.07 foot and line to 0.31 foot. Final grading of invert and trimming was begun and at the end of the year 1,600 feet of tunnel had been prepared substantially ready for placing of concrete lining.

The character of rock continued to be satisfactory, no support of any kind being necessary.

The average weekly progress on tunnel excavation easterly was 58.1 feet and westerly 57.6 feet, the maximum progress being in the week ending December 22, when 69.5 feet were excavated in the east section and 67.5 feet in the west section.

The contractor's force averaged 67 men per day, two shifts being employed.

Work was begun on the installation of concrete plant on November 8. By the end of the year the following plant had been received at the shaft; 1 primary and 1 secondary crushing plant each having a rated capacity of 100 cu. yds. of crushed rock per hour, two weighing hoppers for fine and coarse aggregates, and one screen (60″ diam. x 18′).

The weighing hoppers were installed, and a heavy timbered connecting gallery for belt conveyor constructed. This conveyor is designed to carry the dry material in batches to the head of the shaft. At the end of the year work was in progress on the construction of foundations for the crushing plant, supports for the conveyors, and dragline tower. A similar screen has been delivered at Shaft 5, and some work done on grading for access road and for foundation.

Otherwise than stated above there has been no material change in plant items during the year. One mucking machine was added. In all eleven pumps were used in connection with tunnel construction. The largest has a rated capacity of 450 gals. per min. under a 160-ft. head and is driven by a 30 H.P. motor. The combined compressor capacity was 1,532 cu. ft. per min.

Shaft 8. — (Under the supervision of the Coldbrook-Swift Tunnel Division.) Excavation at this shaft has progressed as follows:

Location	Total Excavation to November 30, 1928	Total Excavation during year ending November 30, 1929	Total Excavation to November 30, 1929
East Heading	143 ft.	3,700 ft.	3,843 ft.
West Heading	135 ft.	4,220 ft.	4,355 ft.
Total	278 ft.	7,920 ft.	8,198 ft.

Weekly advances during January, when two single shifts were used, averaged about 42 feet in each heading. After starting two double shifts in February these weekly advances increased to about 88 feet in each heading until the middle of October when water was encountered in the east heading, cutting down the progress in this heading very materially.

The tunnel is being driven with a heading and bench method, the bench being about six feet long and six feet high.

The force employed by the contractor has averaged 79 men, two shifts being employed.

The principal items of plant at Shaft 8 were as follows:

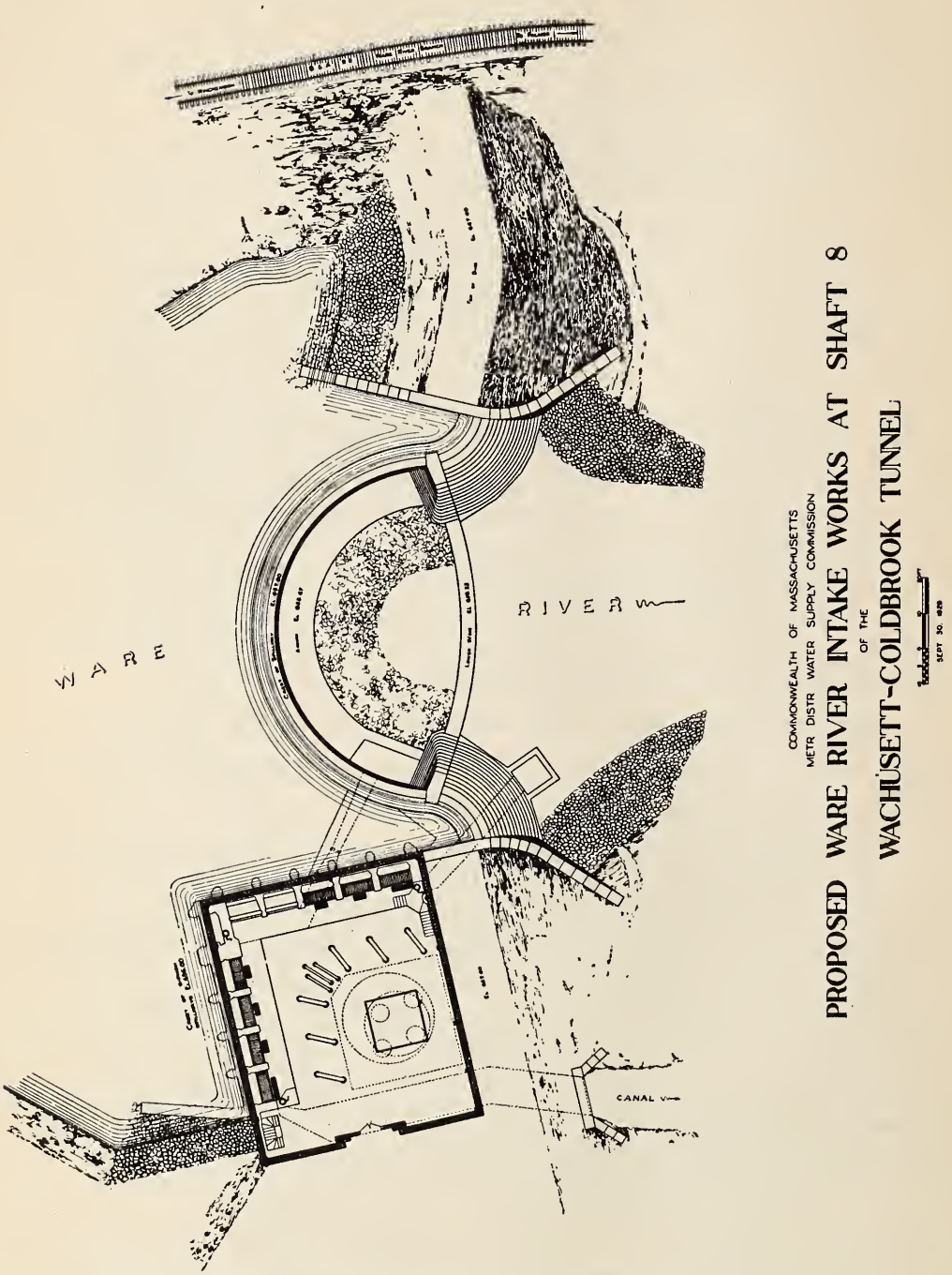
3 Air Compressors, each of 750 cu. ft. per min. capacity, run by 100 H.P. motors.
1 14′0″ x 4′6″ air receiver tank,
1 Blower, rated at 4,100 cu. ft. of free air per min. run by 60 H.P. motor.
1 Mine Hoist.
1 Gasoline driven locomotive.
4 Mucking machines.
10 Pumps, the largest of which has a rated capacity of 1,000 gals. per min. under 100-ft. head run by 40 H.P. motor.
Cars, drill equipment, machine shop equipment, etc.

The total work done and materials furnished to date under the principal items of Contract 17 were as follows:

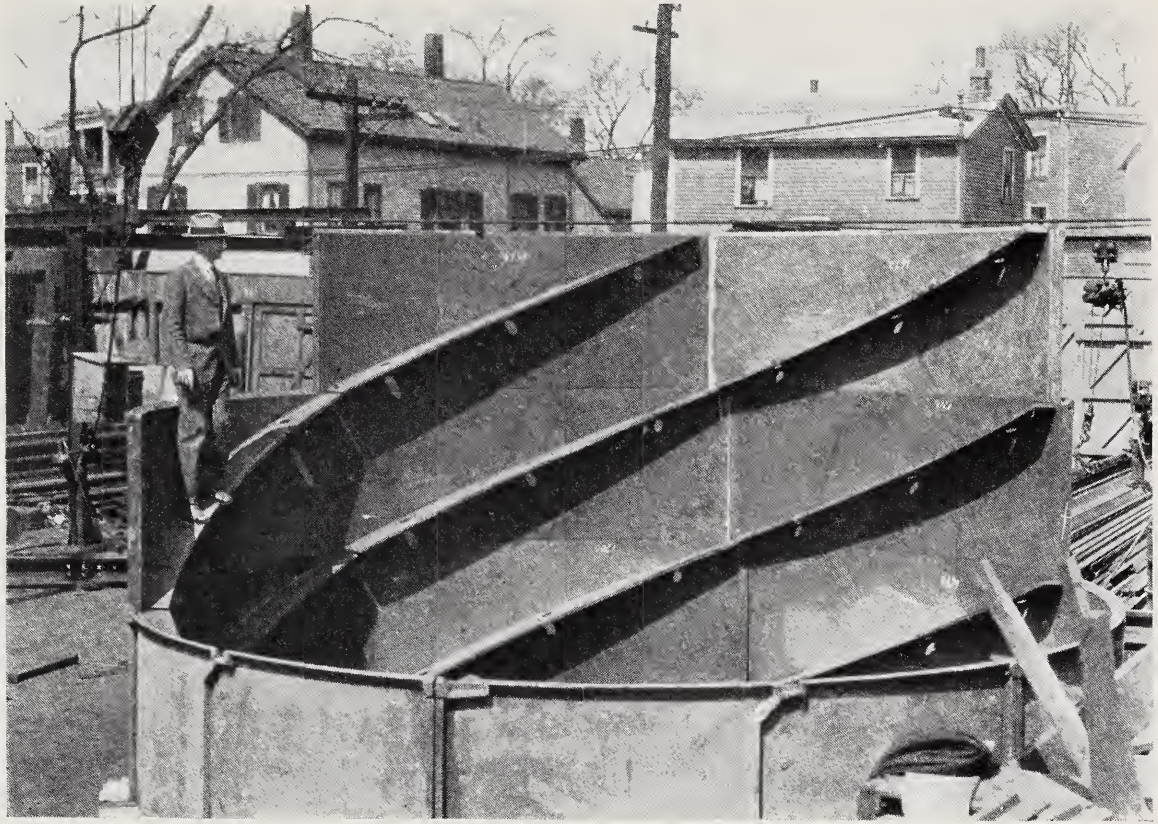
	Shaft 5	Shaft 6	Shaft 7	Shaft 8
Rock excavation in shafts, and in tunnel within 50′ of shafts (cu. yds.)	–	–	–	4,664
Excavation in tunnel except within 50′ of shafts (cu. yds.)	70,515	55,467	52,310	54,811
Shaft and tunnel drainage (lin. ft.)	7,648	7,419	6,001	5,443
Forms for preliminary concrete lining, Shaft 8, (lin. ft.)	–	–	–	217
Concrete masonry in shafts (cu. yds.)	9	–	–	715
Concrete masonry not in shafts or tunnel (cu. yds.)	–	–	–	300
Permanent timbering in tunnel (M ft. B. M.)	–	–	1.84	–
Temporary timbering in tunnel (M ft. B. M.)	3.44	–	–	–
Portland Cement (bbls.)	12	–	–	1,277
Earth excavation (cu. yds.)	–	–	–	570
Rock excavation except in shafts or tunnel (cu. yds.)	–	–	–	760
The contractor's total force averaged (men)	90	84	67	79

Coldbrook-Swift Tunnel Division — Hardwick Office

The Coldbrook-Swift Tunnel Division continued in charge of the field work in connection with the proposed Coldbrook-Swift Tunnel Extension to the Swift River and of the construction at Shaft 8 of the Wachusett-Coldbrook Tunnel included in Contract 17, and previously described. It also has charge of the construction of the low diversion dam and the Ware River Intake Works at Shaft 8, included in Contract 19.



Plan of Proposed Ware River Intake Works at Shaft 8.



CONTRACT 18. — Cast iron lining plates for Ware River Intake, Shaft 8, assembled at the Foundry.

Office Work

Maps were made of properties acquired by the Commission in the vicinity of the village of Coldbrook and along the Ware River above Coldbrook. Ownership of real estate along the line of the proposed Coldbrook-Swift Tunnel was determined and maps were made of property along the tunnel line.

Contour maps were made of various ponds in the Ware River Watershed. Capacity curves were made up for a number of these ponds.

Rain gage stands and thermometer shelters were made for use at the Enfield and White Valley meteorological stations, which stations were put in use on June first. Calculation and tabulation of current meter measurements for ice effect on the controls at the Ware River gaging stations were carried on throughout the winter.

Field Work

Surveys were made of various ponds, mainly in the Ware River Watershed. Investigations were made of the location and condition of wells and springs forming the water supply of the White Valley tenements of the Commission.

A rain gage and a maximum and minimum thermometer were set on June 1, and records kept throughout the year. This office also cooperated with the Boston Office in Hydrographic studies hereinbefore described.

Progress of Contracts

The construction work on the Wachusett-Coldbrook Tunnel from Shaft 8 was supervised from the Hardwick Office and is hereinbefore described.

Contract 18. — Contract 18, for furnishing iron castings for the Ware River Intake Works on the Wachusett-Coldbrook Tunnel in the town of Barre, was executed on January 14, with Barbour Stockwell Company.

These castings include 300 shaft lining plates, 4 nozzle castings to direct the discharge from the Dow disc valves against the lining plates, and 4 base castings to support the valves.

The value of work included in contract estimate to November 10, the date of the latest estimate, was $14,488.72, of which 90% was approved for payment.

The materials furnished under the principal items of Contract 18 were as follows:

Shaft lining plates	191.7 tons
Nozzle castings	24.6 tons
Base castings	3.1 tons

Contract 19. — Contract 19, for constructing the low diversion dam and the substructure of the building for the Ware River Intake Works at Shaft 8 of the Wachusett-Coldbrook Tunnel in the town of Barre, was executed on July 23, with J. W. Bishop Company of Worcester, Mass.

Work started immediately on a road for access to the site. The old mill canal was cleared, using a small caterpillar crane, to take care of the low flow of the river. The channel of the river was cleared with a steam shovel from the dam site to about 200 feet downstream, and two wooden cofferdams were built across the river upstream and downstream from the site, connected by a wooden flume about 12 feet wide and 6 feet deep to carry the flow in excess of the canal capacity. A temporary bridge was built across the Ware River just below the work, and a temporary railroad siding on the south bank from the Boston and Albany Railroad track. Three derricks cover the whole work as well as the siding.

Concreting started about the middle of September. The by-pass sluiceway and Venturi meter for discharging the normal low river flow and piers for five spillway openings in the south side and one in the north side of the intake building substructure were constructed. Grout holes about 20 feet deep and 20 feet apart were drilled along the line of the dam and grouted. Only two holes took any appreciable amount of grout, about 30 bags of cement each. Concrete was proportioned with a weighing aggremeter and was mixed by a three-quarter cubic yard cube mixer.

Stone facing is of Fitchburg granite. The first stone was set on the south abutment on October 25. Stone setting has been carried on since that date.

Refill in the dam and south abutment excavation was started about October 26. This refill was made by puddling the clayey material from the south abutment

excavation, except within the lines of the dike back of the abutment where tamped topsoil was used for impervious fill, and tamped soil and gravel for the remainder.

The culvert under the Boston & Albany Railroad was started about September 23. A pile trestle was put in to support the rails after which excavation was started behind bracing. The concreting for this culvert was finished on October 11, after which the old culvert and the brook bed were filled with earth.

The value of work included in contract estimates to November 15, the date of the latest estimate, was $105,993.41, of which 90% was approved for payment.

The principal items of plant equipment used on Contract 19 were as follows:

2 Derricks with guyed mast and boom
1 Stiff leg derrick
1 ¾-cubic yard concrete mixer
1 Concrete aggremeter, bins and scales
1 Steel concrete chuting tower.

The contractor's force averaged 55 men. The maximum force during any one week was 74 men for the week ending October 12.

Swift River Reservoir Division — Enfield Office

The Swift River Reservoir Division continued in charge of the field work in the Swift River Valley in connection with the proposed Swift River Reservoir.

The major engineering activities of this division were the continuance of topographic surveys of the proposed reservoir basin, general surveys of real estate required for reservoir purposes, and preparation of maps of all surveys.

Topography. — During the year 5,915 acres of topography within and adjacent to the proposed reservoir were surveyed making the total to date 22,775 acres or 35.59 square miles. During the year 6,560 acres of topography were mapped, making the total mapped to date 22,600 acres. Of this total, tracings have been made covering 17,365 acres. Field and office studies were made of possible power transmission lines for supplying power during the construction of the reservoir and appurtenances. Miscellaneous preliminary studies and maps were made to furnish data required by the designing division. 292 acres were surveyed for preliminary studies of highway relocation.

Real Estate. — Property described in application by owners for sale of real estate was located and sketches showing the approximate location made. Property purchased by the Commission during the year, as the deeds were received in the Enfield Office, was plotted on the general property map with a scale 1 inch = 1,000 feet. Comprehensive real estate surveys were continued throughout the year to ultimately include the entire area required for reservoir purposes. The work included analyses of old deeds and suggested descriptions for deed conveyances.

The real estate surveys during the year covered 16,585 acres, making a total to date of 52,500 acres or 82.03 square miles. Of this total, 50,775 acres have been plotted at a scale of 1 inch = 200 feet.

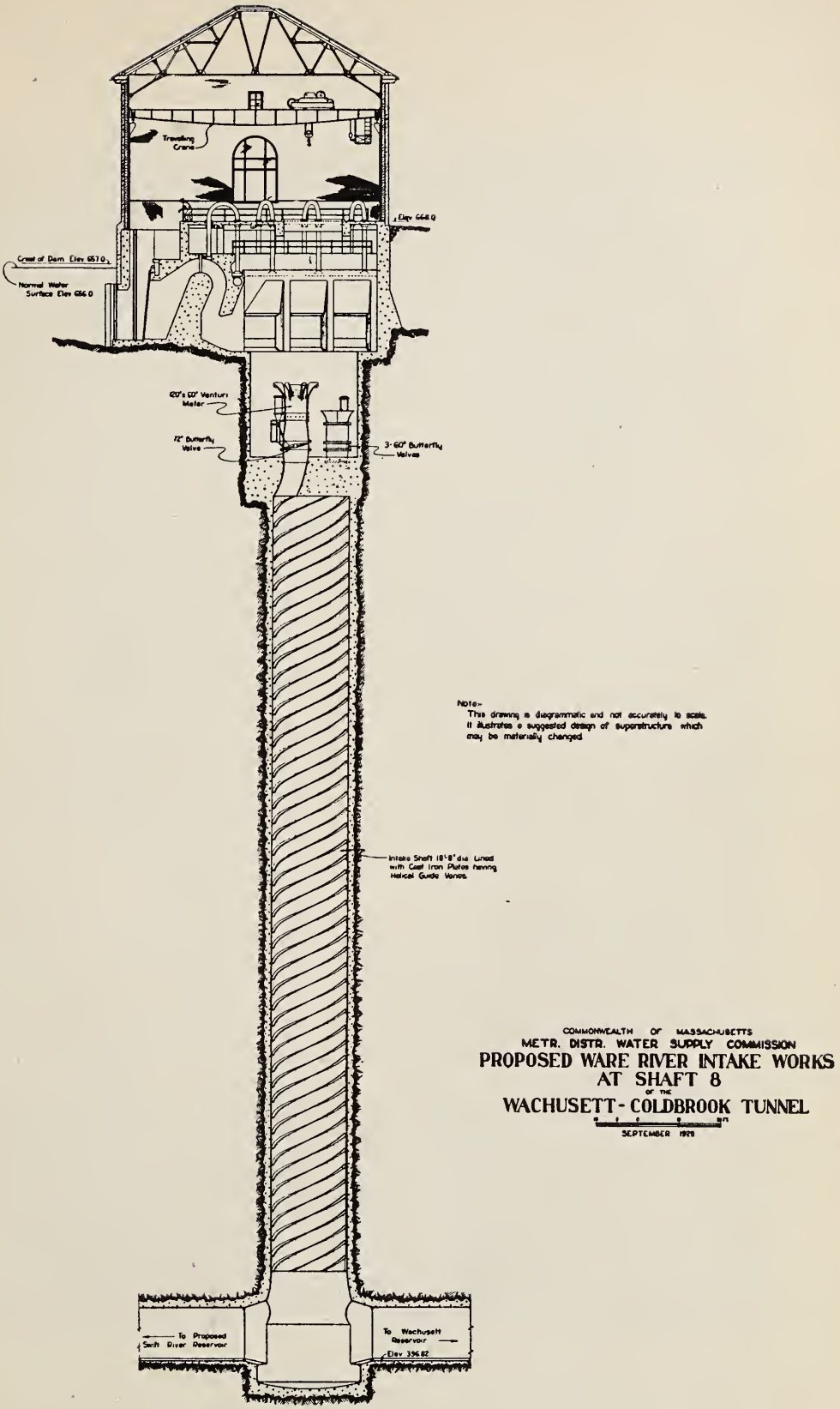
Photography. — Photographs of all buildings which have been listed for purchase were taken and record prints made. During the year 185 photographs of buildings, cemetery lots, and other special features in the Swift River Valley were taken. The photographic facilities of this division were also utilized by other divisions to show progress on construction contracts.

Cemeteries. — A card index was made embracing data relative to each marked interment in cemeteries within the reservoir area. A similar index of cemetery lots was started to include data relative to lot ownership. Relationship of the deceased one to another together with relationship of living interested parties was determined as required.

There has been no general removal of bodies from within the proposed reservoir and such removals as have been made were at the request of interested parties. During the year 212 bodies were removed from 72½ lots in various cemeteries in the area to be affected by the reservoir, together with 81 headstones and 34 monuments, making a total removed to date of 252 bodies, 99 headstones, and 41 monuments.

Soil Testing. — In anticipation of the necessity for the selection of proper materials for embankment fill in the proposed dam and dike, studies were made of recent

Contract 19. — Ware River Diversion Dam, Substructure of Intake Works and headframe of Shaft 8 in background.



Plan of Proposed Ware River Intake Works at Shaft 8.

developments in soil testing methods with particular reference to the permeability of soils such as may be encountered in the Swift River Valley. Through the courtesy of the Massachusetts Institute of Technology, one assistant of this division has spent some time in the Institute Soil Mechanics Laboratory studying various methods and equipment for the testing of the permeability of fine soils.

A laboratory located in the office basement was partially equipped to test the quality of soils available for construction purposes. Numerous samples of top soil were collected from the vicinity of the dam site for testing.

Fire Protection. — The fire fighting equipment housed at Enfield and consisting of a truck, fire pump and general tools, was kept in proper shape for immediate use. Six assistant engineers of this division were reappointed as deputy forest wardens in each of the towns affected by the reservoir.

Because of the extremely dry summer and the consequent drying up of streams which resulted in possible long carries for water, an extra 2,000 feet of one-inch hose was added to the equipment, making a total of 4,500 feet available.

The equipment and personnel responded during the year to calls for assistance at 27 forest fires which burned over a total area of 148 acres. The apparatus also responded to fires in 11 buildings in the valley.

Reforestation. — In the spring 2,000 white pine and 4,000 red pine transplants were received from the State Forest Nursery at Amherst and planted on five acres of land of the Commission in the town of Dana outside the flow line of the proposed reservoir. The young pine survived the summer in good condition.

Blister Rust Control. — In cooperation with the State Department of Agriculture's Bureau of Plant Industry, labor was supplied by this office for the eradication of currant and gooseberry bushes for the control of pine blister rust in that portion of the Swift River Valley above the proposed reservoir flow line. Transportation and supervision were supplied by the Bureau of Plant Industry. The area covered in the cruises for eradication was about 8,300 acres in six towns and 13,056 bushes were destroyed.

Contract 23. — Contract 23 for making borings in the towns of Belchertown, Enfield, Ware, Greenwich and Hardwick was executed on November 5, with Sprague and Henwood, Inc., of Scranton, Pennsylvania. No estimates for payment were made before November 30. The work was confined to explorations in the vicinity of the proposed tunnel portal in the town of Greenwich.

Geologic al Data

Chapter 321, Acts of 1927, provides that the Commission shall collect and publish in its reports such information as to the geology of the region in which any of the work which it is authorized to construct may be located as may be of value in connection with the geological history of the State. Such information, in preliminary form, has been published in the annual reports for the years ending November 30, 1927 and 1928. The geological data have been assembled by Frank E. Fahlquist, Assistant Engineer, under the supervision of Charles P. Berkey, Consulting Geologist.

To date an aggregate length of about 65,000 feet or approximately 87 per cent of the total length of tunnel now under contract has been excavated, and the excavation between Shafts 6 and 7 in the Town of Rutland has been completed.

The method used in obtaining and coordinating geological information is as follows:

A continuous geologic plan and profile of the tunnel excavations on a scale of 20 feet equals 1 inch, was adopted for recording the different geological phenomena observed. All rock types together with their structural features and mineralogical habit have been plotted directly on this profile together with descriptive and explanatory notes. A record is thus being kept of the geological conditions and rock structure including the measurement of each important joint or fracture for location, strike and dip, and a notation of direction and amount of movement.

Specimens have been taken at twenty-five foot intervals throughout the tunnel and, in addition, suites of specimens representing unusual conditions have been collected when it seemed advisable. These specimens, properly labelled as to location, are housed in cases at present in the Holden Office where they are readily accessible for reference. Numerous rock thin sections have been made for more

Paxton Schist in Tunnel, Shaft 4, showing the distinctly banded and laminated appearance, and presence of large and small lens-shaped pegmatite bodies.

detailed study under the microscope. Points of special interest have been photographed.

Work on the several formations within the tunnel area has been extended, as time permitted, into the Worcester basin in an attempt to establish a definite age and structural relation with the Worcester Phyllite recognized by previous workers as of Carboniferous Age.

Cooperation has been given to several geologists who desired to take advantage of the unusual opportunity afforded to study the tunnel excavations at first hand. In a few cases this has led to further investigation of certain specific problems, which still continues.

General Summary of Observations. — No new formations, other than those previously reported, have been discovered in any of the tunnels, but new information as to their distribution has been obtained.

The phyllitic quartzite, in the stretch of tunnel excavated west from Shaft 1, has continued about the same in its mineralogy and structural habit. It is not possible, at this time, to state the nature of the contact between this formation and the Fitchburg Granite to the West, and the exposure of the contact between the two should reveal much valuable geologic information and clarify a few of the points at present undetermined.

The Fitchburg Granite of Shaft 2. — The character of the rock in the tunnel at Shaft 2, known and mapped in the preliminary geological map of Massachusetts as the Fitchburg Granite, has likewise continued in its behavior and occurrence as reported previously. The formation contains extensive bodies of schist, which are now recognized as remnants of the former roof or cover that existed before the invasion of the granite. This cover of schist appears to have been soaked in place by granitic juices which resulted in the partial and sometimes complete replacement of the original schist. Wherever the rock appears as a granite it almost always has a distinct foliation, which is parallel or closely parallel to the structure of the nearby schist bodies. This fact is clearly recognized from the plotted observations of 9,000 feet of geologic profile taken in this section. It appears, then, that it will be quite possible to piece together the structural information in the granite belt and determine partially at least the attitude and behavior of the original schist during deformation.

Pegmatite, in its simplest habit, occurs extensively both in the schist areas and the granite areas, but seldom in bodies of sharp outline. They usually are of irregular shape with transition zones between this type and the surrounding rock. In the more schistose zones the pegmatite frequently occurs in the form of feldspar bunches and augen, and generally contains quartz, biotite, and feldspar, with only occasional muscovite and black tourmaline. No other minerals, such as sometimes occur in pegmatites, have been found.

The widespread general occurrence of these three types of rock suggests an interesting problem as to origin; whether formed, as most granites are believed to have been, by crystallization of a granitic liquid or magma, or instead by intense granitization of the overlying schist by soaking and replacement.

The structure throughout is moderately flat, with few zones where the structure is steep for short distances and sometimes even vertical. These zones of strong structure, which are often highly injected, may have special significance in the general structural problem of the area.

The Paxton and Brimfield Schists of the Central Belt. — Excavations in the central belt of schists between Shaft 3 and 8 has revealed one new fact in the stratigraphic distribution of the Paxton and Brimfield schists of the preliminary geological map of Massachusetts. These two types are now believed to be simply different lithologic members of the same formation, since the Brimfield Schist type lies conformably both above and below the Paxton Schist. The Paxton Schist type appears to be the more extensive member as exposed in the tunnel where it extends from a point about 4,500 feet west of Shaft 5 to a point about 500 feet east of Shaft 4. Throughout this section of approximately 17,000 feet it maintains a low easterly dip. It occurs again in the tunnel at Shaft 6 extending at least 6,800 feet from a point about 2,000 feet west of the shaft to the east heading and indicating that a short stretch of Brimfield Schist type separates it from the Paxton of Shaft 5. It next occurs in the tunnel east of Shaft 7 where it is exposed for about 3,000 feet, and maintains a gentle easterly dip.

The Brimfield Schist type extends throughout the tunnels between Shafts 7 and 8 and westerly, forming a rather broad and low anticlinal fold. It appears also, that it would extend from the conformable contact east of Shaft 4, through Shaft 3 and make a contact with the Fitchburg Granite at some point east of Shaft 3, not yet revealed by tunnel excavations. Throughout the portion of the section excavated this rock maintains a rather low easterly dip. There is also a short length of about 2,000 feet exposed in the tunnel west of Shaft 6, where it also maintains a moderate easterly dip, passing under the Paxton Schist. This is apparently continuous with the Brimfield type in the tunnel west of Shaft 5.

The Paxton Schist type is the most uniform of the formations encountered. The rock is essentially a medium grained quartz-mica schist with variable amounts of feldspar, often in quantities great enough to make the rock a feldspathic biotite schist. It is distinctly banded and laminated, this effect being produced by variations in the proportions of the main constituents, more especially by the greater concentration of biotite mica in bands. Yet another cause of banded appearance is the occurrence of narrow somewhat discontinuous greenish streaks and layers or lenses, the dominant composition of which is feldspar, quartz, red garnet and green diopside. The presence of the garnet and diopside suggests that the original sediment was an impure feldspathic sandstone containing limy layers.

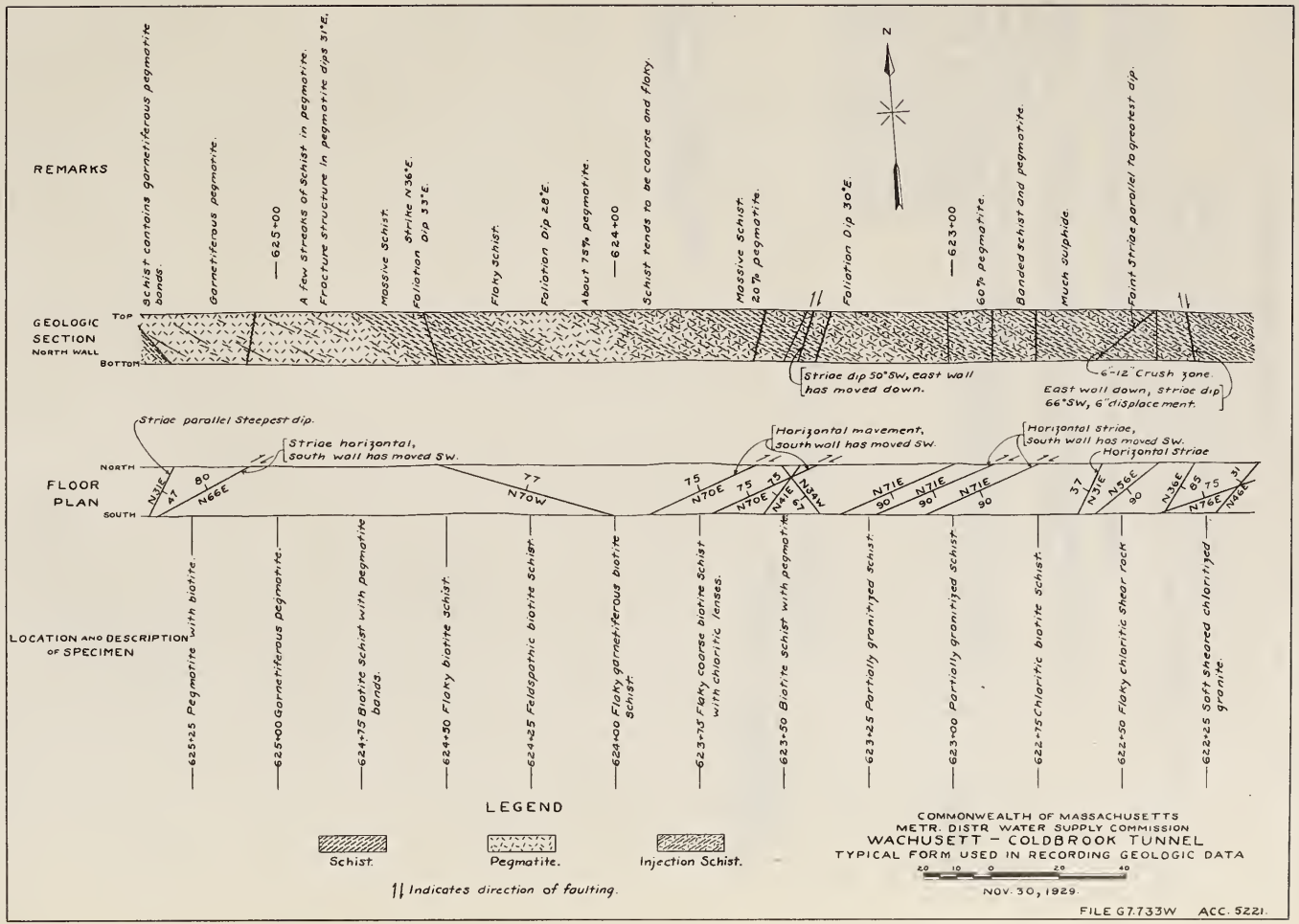
A distinctive feature of this formation is the presence of innumerable lens shaped bodies of pegmatite made up chiefly of feldspar with relatively small amounts of quartz. These bodies, varying from a fraction of an inch to several feet in length, appear to have both replaced and displaced the surrounding schist, and thus present a problem as to origin and method of development.

The Brimfield Schist type, as it occurs in the tunnel excavations, is a rock of great variety in petrographic character and geologic behavior. It is made up of five rock types, (1) a dark brown flaky biotite schist with very little quartz or feldspar but commonly containing garnet, (2) a highly quartzose biotite schist or a biotite meta-quartzite, (3) a massive feldspathic biotite schist sometimes containing garnet, (4) a gray gneissoid granite and (5) pegmatite. These several types, excepting those of igneous origin, occur in intercalated layers or beds ranging from a few inches to many feet in thickness. This condition had been recognized before and on this account the name of Paxton Mixed Injection Schist was given to the formation, evidence of igneous soaking or injection in some form being present almost everywhere. The pegmatites occur as small feldspar bunches, as thin lenses and bands in the schist producing a banded or ribbon structure, as large lenses in the schist, and as still larger bodies, some of which are sill-like in sections and others of which are very irregular with embayed contacts showing partial replacements of the schist. The granite generally occurs in sill form with sharp margins parallel to the schist structure, but also as irregular masses with margins that are gradational into the surrounding schist. Throughout the formation, especially in zones of crushing and movement, there is considerable development of chlorite and introduction of carbonate and sulphide.

Deformation. — The lack of faulting to any great extent in the tunnels so far excavated in the broad schist belt of the Paxton and Brimfield types is a surprising fact. It is true that evidence of movement has been noted on many of the joint surfaces but the displacements are measured in terms of inches. In most cases the greater part of the movement has been in a horizontal direction. Slips and shear zones have been noted where the greatest component of displacement is vertical.

Several major problems have been recognized and are being studied. Among them are the following:

1. Grouping of the many rock types and varieties into formational units that have a sound genetic basis and that can be defined.
2. The character and thicknesses of the original sediments, and the method of metamorphism into the schists now forming the central belt.
3. Structural relation of the schists in the central part of the tunnel area one to another and to the Oakdale Quartzite and Worcester Phyllite of the Worcester Basin.
4. The geologic age of these formations.


REMARKS
Schist containing garnetiferous pegmatite bands.
Garnetiferous pegmatite.
— 625+00
A few streaks of schist in pegmatite.
Fracture structure in pegmatite dips 31°E.
Massive schist.
Foliation Dip 33°E.
Strike N36°E.
Flaky schist.
Foliation Dip 28°E.
About 75% pegmatite.
— 624+00
Schist tends to be coarse and flaky.
Massive Schist.
20% pegmatite.
Foliation Dip 30°E.
— 623+00
60% pegmatite.
Banded schist and pegmatite.
much sulphide
Faint Strike parallel to greatest dip.
GEOLOGIC SECTION
NORTH WALL
TOP
BOTTOM
Strike dip 50°SW, east wall has moved down.
6-12" Crush zone.
East wall down, strike dip 66°SW, 6" displacement.
FLOOR PLAN
NORTH
SOUTH
Strike parallel Steepest dip.
Strike horizontal, south wall has moved SW.
Horizontal movement, south wall has moved SW.
Horizontal Strike, south wall has moved SW.
Horizontal Strike
N31E 47
80 N66E
77 N70W
75 N70E
75 N70E
75 N70E
N41E 67
N34W
N71E 90
N71E 90
N71E 90
37 N31E
N56E 90
N36E 85
75 N76E
31 N46E
LOCATION AND DESCRIPTION OF SPECIMEN
625+25 Pegmatite with biotite.
625+00 Garnetiferous pegmatite.
624+75 Biotite schist with pegmatite bands.
624+50 Flaky biotite schist.
624+25 Feldspathic biotite schist.
624+00 Flaky garnetiferous biotite schist.
623+75 Flaky coarse biotite schist with chloritic lenses.
623+50 Biotite schist with pegmatite.
623+25 Partially granitized schist.
623+00 Partially granitized schist.
622+75 Chloritic biotite schist.
622+50 Flaky chloritic shear rock
622+25 Soft sheared chloritized granite.
LEGEND
Schist.
Pegmatite.
Injection Schist.
// Indicates direction of faulting.
COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
WACHUSETT – COLDBROOK TUNNEL
TYPICAL FORM USED IN RECORDING GEOLOGIC DATA
20 10 0 20 40
NOV. 30, 1929.
FILE G7.733W ACC. 5221.

5. The relation of schist bodies in the granite of the eastern section to the central belt of schist and likewise to the Worcester basin sediments.

6. The mode of injection into the schists and the relative amounts of replacement and displacement.

7. The mode of development of the granite in the eastern section and the relative amount of true intrusive granite belonging to the formations as they now exist.

8. Nature of later deformation affecting the region as shown by jointing, shearing and faulting.

9. The petrology of the different formations.

List of Drawings and Tables

For General Plan of Metropolitan Water Supply and Profile of Wachusett-Coldbrook Tunnel, see Second Annual Report.

The following tabulations are appended to this report:

Monthly Progress — Real Estate Negotiations for Swift River Reservoir.
Location of Real Estate Acquired for the Swift River Reservoir.
Real Estate Takings.
Status of Contracts Completed Prior to Nov. 30, 1928.
Status of Contracts in Force between Nov. 30, 1928, and Nov. 30, 1929.
Total Value of Work Accomplished under Contracts in Progress During Year Ending Nov. 30, 1929 — Shown Monthly.
Canvass of Bids, Contract 18.
Canvass of Bids, Contract 19.
Canvass of Bids, Contract 22.
Canvass of Bids, Contract 23.

Respectfully submitted,

FRANK E. WINSOR,
Chief Engineer.

24 School Street, Boston, Mass.
December 27, 1929.

FINANCIAL STATEMENT OF THE METROPOLITAN DISTRICT WATER SUPPLY COMMISSION

Expenditures and Disbursements for the Fiscal Year and from July 28, 1926, the Date of the Appointment of the Commission

General Overhead

	Year ending Nov. 30, 1929	Total to Nov. 30, 1929
Administration (Commissioners' Office):		
Salaries, Commissioners	$10,500.00	$35,112.80
Salaries, Clerical	10,591.64	28,320.67
General Legal Expense	0.00	1,377.30
Furniture and Fixtures	79.53	1,894.31
Rent and Upkeep	3,101.05	6,062.76
Automobile Purchase	595.00	1,404.00
Automobile Maintenance	290.54	959.02
Miscellaneous Expense (undistributed)	667.97	5,400.77
Advertising	1,405.33	2,153.98
Printing and Blueprinting	993.74	2,115.59
Stationery and Office Supplies	295.26	585.21
Postage	116.00	249.69
Total Administration	$28,636.06	$85,636.10
Engineering, Headquarters Office:		
Salaries, Engineering	$86,719.81	$233,154.91
Salaries, Clerical	9,504.31	26,820.11
General Consultant Expense	16,047.89	42,545.41
General Legal Expense	244.69	244.69
Furniture and Fixtures	343.91	10,751.73
Laboratory Equipment	130.28	1,556.46
Laboratory Supplies	562.99	1,932.49
Rental of Equipment	1,996.76	2,861.76
Engineering Instruments	22.92	63.54
Rent and Upkeep of Boston Office	9,521.71	31,101.33
Rent and Upkeep of Springfield Laboratory	1,769.15	2,346.03
Automobile Purchase	595.00	2,090.70
Automobile Maintenance	818.69	1,625.99
Special Experiments	0.00	2,304.63
Miscellaneous Expense (undistributed)	3,231.83	11,521.11
Printing and Blueprinting	1,719.86	4,107.57
Stationery and Office Supplies	565.86	1,473.15
Postage	217.26	422.33
Total Engineering, Headquarters Office	$134,013.62	$376,923.94
Unassigned:		
Unassigned Supplies and Equipment	−$61.90	$1,006.91
Total Unassigned	−$61.90	$1,006.91
Total General Overhead	$162,587.78	$463,566.95

Distribution of General Overhead

	Year ending Nov. 30, 1929	Total to Nov. 30, 1929
Administration:		
Wachusett-Coldbrook Tunnel Division	$13,836.87	$34,597.08
Coldbrook-Swift Tunnel Division	2,062.05	5,431.57
Swift River Reservoir Division	12,727.55	36,952.73
Southern Sudbury Emergency Supply	9.59	8,654.72
Total Administration	$28,636.06	$85,636.10
Engineering, Headquarters Office:		
Wachusett-Coldbrook Tunnel Division	$53,410.85	$139,356.71
Coldbrook-Swift Tunnel Division	14,261.12	26,597.68
Swift River Reservoir Division	66,035.80	177,666.28
Southern Sudbury Emergency Supply	305.85	33,303.27
Total Engineering, Headquarters Office	$134,013.62	$376,923.94

Wachusett-Coldbrook Tunnel Division

General Overhead:		
Administration	$13,836.87	$34,597.08
Engineering	53,410.85	139,356.71
Total General Overhead	$67,247.72	$173,953.79
Engineering:		
Salaries, Engineering and Clerical	$82,585.10	$195,443.85
Consultant Expense	1,893.19	3,521.25
Furniture and Fixtures	416.68	1,487.31
Engineering Instruments	245.94	7,386.94
Rent and Upkeep	2,163.54	6,091.18
Automobile Purchase	2,303.25	6,818.21
Automobile Maintenance	2,262.40	7,368.39
Contracts for Investigations and Surveys	0.00	16,075.11
Miscellaneous Expense (undistributed)	1,152.54	4,140.06
Advertising	1.83	6.05
Printing and Blueprinting	140.38	532.39
Stationery and Office Supplies	279.70	1,618.60
Postage	36.64	211.99
Total Engineering	$93,481.19	$250,701.33
Real Estate (General Construction):		
Legal and Expert Expense	$488.56	$4,001.02
Consultant Expense	0.00	394.40
Labor	−110.00	906.55
Miscellaneous Expense	0.00	241.24
Purchases and Settlements	10,557.25	106,939.71
Taxes	1,280.86	2,037.98
Maintenance of Real Estate	218.39	218.39
Police Protection, Labor	5.00	15.00
Special Agents, Salaries	2,310.00	3,393.00
Furniture and Fixtures	0.00	117.67
Automobile Purchase	0.00	595.50
Automobile Maintenance	608.12	729.81
Miscellaneous Expense (undistributed)	362.61	438.96
Printing	0.00	7.89
Postage	0.36	0.36
Total Real Estate	$15,721.15	$120,037.48

	Year ending Nov. 30, 1929	Total to Nov. 30, 1929
WARE WATERSHED PROTECTION:		
Salaries, Engineering	$2,729.52	$2,729.52
Legal and Expert Expense	1,194.49	3,918.92
Consultant Expense	0.00	763.70
Labor	780.00	2,045.00
Miscellaneous Expense	142.40	188.24
Printing and Blueprinting	22.04	22.04
Purchases and Settlements	125,857.71	420,346.37
Taxes	−1,952.26	3,008.66
Total Ware Watershed Protection	$128,773.90	$433,022.45
WARE DIVERSION DAMAGES:		
Salaries, Engineering and Clerical	$12,916.73	$12,916.73
Consultant Expense	1,490.78	1,943.17
Labor	19.62	19.62
Miscellaneous Expense (undistributed)	1,229.85	2,824.88
Printing and Blueprinting	42.56	67.55
Postage	0.75	0.75
Engineering Instruments	45.08	45.08
Laboratory Equipment	37.14	37.14
Laboratory Supplies	27.88	27.88
Rental of Equipment	36.25	36.25
Contracts for Investigations and Surveys	0.00	63.27
Total Ware Diversion Damages	$15,846.64	$17,982.32
PERMANENT CONSTRUCTION — CONSTRUCTION CONTRACTS:		
Contract No. 4, Sinking Shaft 5 and driving 1,367 linear feet of tunnel	$0.00	$290,581.99
Contract No. 8, Sinking Shafts 6 and 7 and driving 3,062.2 linear feet of tunnel	0.00	456,784.26
Contract No. 10, Construction and maintenance of Transmission Line	6,819.87	102,584.96
Contract No. 12, Sinking Shafts 2, 3 and 4 and driving 3,809.6 linear feet of tunnel	0.00	632,727.44
Contract No. 14, Construction of East Portion of Wachusett-Coldbrook Tunnel and Shaft 1	1,407,510.58	1,649,160.71
Contract No. 17, Construction of West Portion of Wachusett-Coldbrook Tunnel and Shaft 8	1,949,794.19	2,392,237.47
Contract No. 18, Furnishing Iron Castings for the Ware River Intake Works of the Wachusett-Coldbrook Tunnel	13,039.85	13,039.85
Contract No. 19, Construction of Dam, and Substructure of Intake Building for the Ware River Intake Works of the Wachusett-Coldbrook Tunnel	95,394.07	95,394.07
Total Contracts	$3,472,558.56	$5,632,510.75
PERMANENT CONSTRUCTION — EXCEPT CONSTRUCTION CONTRACTS:		
Installed Equipment	$9,809.96	$9,901.84
Temporary Equipment	283.00	5,033.10
Miscellaneous Expense	987.99	1,876.01
Investigations and Surveys	0.00	898.34
Total	$11,080.95	$17,709.29
Total Wachusett-Coldbrook Tunnel Division	$3,804,710.11	$6,645,917.41

Coldbrook-Swift Tunnel Division

	Year ending Nov. 30, 1929	Total to Nov. 30, 1929
General Overhead:		
Administration	$2,062.05	$5,431.57
Engineering	14,261.12	26,597.68
Total General Overhead	$16,323.17	$32,029.25
Engineering:		
Salaries, Engineering and Clerical	$4,547.46	$32,845.15
Furniture and Fixtures	200.46	425.95
Engineering Instruments	70.48	3,355.25
Rent and Upkeep	1,151.24	2,890.10
Automobile Purchase	2,331.75	4,311.75
Automobile Maintenance	3,115.89	5,479.04
Contracts for Investigation and Surveys	0.00	12,831.65
Materials of Construction	0.00	2.25
Miscellaneous Expense (undistributed)	651.49	2,499.22
Printing and Blueprinting	95.72	208.81
Stationery and Office Supplies	242.81	838.47
Postage	45.19	139.12
Total Engineering	$12,452.49	$65,826.76
Real Estate:		
Legal and Expert Expense	$1,157.51	$1,571.33
Miscellaneous Expense (undistributed)	0.00	12.30
Printing and Blueprinting	0.67	0.67
Purchases and Settlements	−236.30	0.00
Taxes	−867.47	0.00
Fire Protection Equipment	0.00	17.06
Total Real Estate	$54.41	$1,601.36
Permanent Construction — Except Construction Contracts:		
Installed Equipment	$0.00	$91.87
Total	$0.00	$91.87
Total Coldbrook-Swift Tunnel Division	$28,830.07	$99,549.24

Swift River Reservoir Division

General Overhead:		
Administration	$12,727.55	$36,952.73
Engineering	66,035.80	177,666.28
Total General Overhead	$78,763.35	$214,619.01
Engineering:		
Salaries, Engineering and Clerical	$63,746.77	$192,228.84
Labor	871.94	871.94
Furniture and Fixtures	1,321.00	2,488.17
Engineering Instruments	39.98	5,435.89
Rent and Upkeep	1,055.73	1,664.90
Automobile Purchase	2,411.75	8,468.71
Automobile Maintenance	2,445.05	7,616.53
Special Experiments	119.88	119.88
Contracts for Investigations and Surveys	0.00	35,448.91
Rental of Equipment	0.50	0.50

	Year ending Nov. 30, 1929	Total to Nov. 30, 1929
ENGINEERING — *Concluded.*		
Office Buildings	$3,092.38	$4,015.61
Miscellaneous Expense (undistributed)	339.95	2,489.69
Printing and Blueprinting	231.62	757.66
Stationery and Office Supplies	375.15	2,748.52
Postage	61.74	265.10
Total Engineering	$76,113.44	$264,620.85
REAL ESTATE:		
Legal and Expert Expense	$22,998.39	$77,692.00
Labor	0.00	56.10
Furniture and Fixtures	15.68	15.68
Miscellaneous Expense (undistributed)	639.19	1,402.44
Advertising	92.97	112.26
Printing and Blueprinting	49.80	49.80
Stationery and Office Supplies	0.00	0.45
Purchases and Settlements	1,138,916.48	3,241,937.46
Taxes	20,176.69	34,528.20
Maintenance of Real Estate	529.82	529.82
Fire Protection Equipment	686.81	2,504.24
Automobile Purchase	0.00	200.00
Automobile Maintenance	53.74	90.35
Miscellaneous Expense	41.25	55.61
Special Agents, Salaries	2,310.00	3,741.33
Equipment	0.00	118.33
Automobile Purchase	0.00	609.96
Automobile Maintenance	559.45	833.73
Miscellaneous Expense (undistributed)	169.22	335.13
Printing and Blueprinting	0.00	41.60
Postage	1.00	2.42
Stationery and Office Supplies	3.52	3.52
Renting Agents, Salaries	2,500.00	4,655.43
Furniture and Fixtures	0.00	29.29
Miscellaneous Expense	92.43	106.47
Payments to Towns	2,000 00	2,000 00
Total Real Estate	$1,191,836.44	$3,371,651.62
SWIFT RESERVOIR DAMAGES:		
Salaries, Engineering	$14.58	$14.58
Consultant Expense	0.00	921.47
Purchases and Settlements	6,046.00	6,046.00
Miscellaneous Expense	1.90	1.90
Total Swift Reservoir Damages	$6,062.48	$6,983.95
SWIFT DIVERSION DAMAGES:		
Salaries, Engineering	$6,284.86	$9,296.72
Consultant Expense	725.15	2,085.69
Engineering Instruments	529.70	529.70
Laboratory Equipment	19.99	19.99
Automobile Maintenance	0.00	1.25
Contracts for Investigations and Surveys	0.00	569.47
Laboratory Supplies	20.98	20.98
Miscellaneous Expense (undistributed)	716.42	2,781.88
Printing and Blueprinting	46.57	46.57
Total Swift Diversion Damages	$8,343.67	$15,352.25

	Year ending Nov. 30, 1929	Total to Nov. 30, 1929
CEMETERIES:		
Salaries, Engineering and Clerical	$1,317.51	$1,317.51
Legal and Expert Expense	25.75	25.75
Labor	1,585.88	2,130.88
Miscellaneous Expense (undistributed)	13.99	65.80
Stationery and Office Supplies	3.51	3.51
Purchases and Settlements	1,320.50	1,876.50
Monuments and Inscriptions	236.55	236.55
Materials	544.16	883.59
Transportation of Bodies	0.00	45.00
Transportation of Monuments	249.00	382.00
Total Cemeteries	$5,296.85	$6,967.09
PERMANENT CONSTRUCTION — EXCEPT CONSTRUCTION CONTRACTS:		
Installed Equipment	$0.00	$214.78
Total	$0.00	$214.78
Total Swift River Reservoir Division	$1,366,416.23	$3,880,409.55
SOUTHERN SUDBURY EMERGENCY SUPPLY		
GENERAL OVERHEAD:		
Administration	$9.59	$8,654.72
Engineering	305.85	33,303.27
Total General Overhead	$315.44	$41,957.99
ENGINEERING:		
Salaries	$587.49	$33,810.46
Consultant Expense	0.00	3,816.25
Furniture and Fixtures	0.00	30.70
Engineering Instruments	0.00	216.06
Rent and Upkeep	0.00	543.40
Automobile Purchase	0.00	1,919.00
Automobile Maintenance	0.00	1,514.45
Labor	0.00	173.00
Miscellaneous Expense (undistributed):	277.23	1,575.75
Printing and Blueprinting	0.00	215.33
Stationery and Office Supplies	0.00	567.87
Postage	0.00	52.80
Total Engineering	$864.72	$44,435.07
REAL ESTATE:		
Legal and Expert Expense	$360.37	$1,814.24
Consultant Expense	0.00	116.87
Purchases and Settlements	2,825.00	16,488.22
Total Real Estate	$3,185.37	$18,419.33
SOUTHERN SUDBURY DIVERSION DAMAGES:		
Consultant Expense	$0.00	$869.50
Legal and Expert Expense	6.93	212.66
Settlements	550.00	24,550.00
Total Southern Sudbury Diversion Damages	$556.93	$25,632.16

	Year ending Nov. 30, 1929	Total to Nov. 30, 1929
PERMANENT CONSTRUCTION — CONSTRUCTION CONTRACTS:		
Contract No. 5, Cordaville Pipe Line	$0.00	$83,262.86
Contract No. 6, Cordaville Pumping Station	0.00	17,385.04
Contract No. 7, Hopkinton Pipe Line	0.00	134,365.72
Contract No. 11, Ashland Pipe Line	0.00	130,145.35
Contract No. 13, Whitehall Pipe Line	0.00	60,603.17
Contract No. 16, Whitehall Open Channel	0.00	32,695.16
Total Contracts	$0.00	$458,457.30
PERMANENT CONSTRUCTION — EXCEPT CONSTRUCTION CONTRACTS:		
Installed Equipment	$0.40	$7,960.51
Miscellaneous Expense	9.69	2,758.77
Labor	0.00	1,011.00
Materials of Construction	0.00	207.09
Total	$10.09	$11,937.37
Total Southern Sudbury Emergency Supply	$4,932.55	$600,839.22
SUMMARY		
Wachusett-Coldbrook Tunnel Division	$3,804,710.11	$6,645,917.41
Coldbrook-Swift Tunnel Division	28,830.07	99,549.24
Swift River Reservoir Division	1,366,416.23	3,880,409.55
Southern Sudbury Emergency Supply	4,932.55	600,839.22
Unassigned	−61.90	1,006.91
Grand Total	$5,204,827.06	$11,227,722.33
RECEIPTS FROM RENTS, SALES, ETC.		
Receipts from Sales	$21,680.90	$29,196.57
Receipts from Rents	38,121.32	57,965.33
Miscellaneous Receipts	58.90	110.38
Total Receipts	$59,861.12	$87,272.28

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION

MONTHLY PROGRESS – REAL ESTATE NEGOTIATIONS FOR SWIFT RIVER RESERVOIR

DATE	OWNERS' OFFERS TO SELL TO COMMONWEALTH			TITLE VESTED IN COMMONWEALTH (ACRES)	
	NUMBER OF OFFERS	TOTAL AREA (ACRES)	AREA NOT REQUIRED (ACRES)		
1928 December	12	261	120	658	
1929 January	20	481	132	699	
February	11	498	182	999	
March	9	1,289	0	365	
April	29	644	1	627	
May	26	696	237	1,712	
June	34	662	121	1,782	
July	26	416	171	1,226	
August	24	1,563	289	1,140	
September	9	342	37	693	
October	15	682	120	814	
November	11	1,336	186	474	
Total for Year ending Nov. 30, 1929.	226	8,870	1,596	11,189	
Total — Nov. 30, 1928.	1,210	50,119	5,485	23,597	
Total — Nov. 30, 1929.	1,436	58,989	7,081	34,786	

Options Outstanding Nov. 30, 1929 — 4,136. Acres.
Acreage is based upon estimates obtained from deeds or other information and not from surveys.

COMMONWEALTH OF MASSACHUSETTS

METR. DISTR. WATER SUPPLY COMMISSION

LOCATION OF REAL ESTATE ACQUIRED FOR THE SWIFT RIVER RESERVOIR

(TITLE VESTED IN COMMONWEALTH)

TOWNS	TOTAL NOV. 30, 1928. (ACRES)	TOTAL FOR YEAR ENDING NOV. 30, 1929. (ACRES)	TOTAL NOV. 30, 1929. (ACRES)	REMARKS
BELCHERTOWN	1,095	277	1,372	
DANA	2,189	2,871	5,060	
ENFIELD	5,000	686	5,686	
GREENWICH	4,685	1,836	6,521	
HARDWICK	556	1,546	2,102	
NEW SALEM	2,453	1,680	4,133	
PELHAM	1,149	499	1,648	
PETERSHAM	352	68	420	
PRESCOTT	5,730	1,485	7,215	
SHUTESBURY	133	215	348	
WARE	254	26	280	
WENDELL	1	0	1	
TOTALS	23,597	11,189	34,786	

NOTE:- Acreage is based upon estimates obtained from deeds or other information and not from surveys.

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION

REAL ESTATE TAKINGS

TAKING FOR		TAKING NO.	TOWN	COUNTY	PLAN NO.	DATE OF TAKING	TITLE VESTED IN COMMONWEALTH FEE (Acres)	TITLE VESTED IN COMMONWEALTH EASEM'T. (Acres)
Wachusett-Coldbrook Tunnel.		1	Holden	Worcester	T-1 to T-5 incl.	July 22, 1927.	186.01	3.91
			Rutland				1.86	
Wachusett-Coldbrook Tunnel.		2	Rutland	Worcester	T-6 to T-12 incl.	Aug. 26, 1927.	90.90	8.92
			Oakham				6.62	2.00
Wachusett-Coldbrook Tunnel.		3	Oakham	Worcester	T-13	Nov. 11, 1927.	103.58	
			Barre				181.25	0.84
Wachusett-Coldbrook Tunnel.		4	West Boylston	Worcester	T-1A	Aug. 21, 1928.		2.57
			Holden					2.13
Coldbrook-Swift Tunnel.		1	Barre	Worcester	T-14	Sept. 24, 1929.		3.53
							570.22	23.90
Ashland Pipe Line	Sudbury Supply	1	Southborough	Worcester	C-1 & C-2	July 8, 1927.		0.85
			Ashland	Middlesex				4.48
Ashland Pipe Line		2	Ashland	Middlesex	C-8 to C-11 incl.	Nov. 11, 1927.		9.13
			Framingham					1.34
Cordaville Pipe Line		3	Southborough	Worcester	C-3 to C-7 incl.	July 8, 1927.	1.14	8.75
Hopkinton Pipe Line		4	Hopkinton	Middlesex	C-12 to C-14 incl.	Oct. 14, 1927.	64.17	4.47
							65.31	29.02
Indian Brook	Southern Emergency	5	Ashland & Hopkinton	Middlesex	No Plan	Sept. 2, 1927.	Water Diversion.	
Cold Spring Brook		6	Ashland	Middlesex	No Plan	Jan. 6, 1928.		
Sudbury River		7	Southborough, Hopkinton, & Westborough	Wor. & Mid'sex Worcester	No Plan	Jan. 6, 1928.		
City Brook & Whitehall Res.		8	Hopkinton	Middlesex	No Plan	Jan. 6, 1928.		

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION

STATUS OF CONTRACTS COMPLETED PRIOR TO NOV. 30, 1928

CONT. NO.	DESCRIPTION	LOCATION	SUPPLY	CONTRACTOR	BIDS OPENED	CONTRACT AWARDED	BASIS OF AWARD	FINAL ESTIMATE	DATE OF FINAL EST.
1	Borings	Tunnel Line	Ware & Swift	Pennsylvania Drilling Company	Nov. 5, 1926	Nov. 9, 1926	8,260.00	18,641.69	July 15, 1927
2	Borings	Swift Dam & Dike Sites	Swift	Sprague & Henwood, Incorporated	Nov. 5, 1926	Nov. 9, 1926	9,730.00	26,885.83	June 3, 1927
3	Aerial Photographs	Swift River Valley	Swift	Fairchild Aerial Surveys, Incorporated		Nov. 12, 1926	6,955.00	5,997.50	Nov. 2, 1927
4	Shaft 5	Rutland	Ware	James J. Coughlan & Sons, Incorporated	Mar. 25, 1927	Mar. 28, 1927	137,854.80	290,581.99*	June 12, 1928
5	Cordaville Pipe Line	Cordaville to Sudbury Res.	So. Sudbury	Lock Joint Pipe Co.	Apr. 15, 1927	Apr. 15, 1927	78,818.00	83,762.86	Jan. 9, 1928
6	Cordaville Pumping Station	Cordaville	So. Sudbury	F. A. Mazzur Co., Inc.	Apr. 29, 1927	May 2, 1927	16,357.00	17,385.04	May 16, 1928
7	Hopkinton Pipe Line	Hopkinton Res. to Cordaville.	So. Sudbury	Cenedella & Co.	Apr. 29, 1927	May 4, 1927	126,550.00	134,365.72	Dec. 27, 1927
8	Shafts 6 & 7	Rutland	Ware	James J. Coughlan & Sons, Incorporated	May 20, 1927	May 24, 1927	162,125.00	456,784.26*	June 12, 1928
9	Aerial Photographs	Chicopee and Ware Rivers	Ware	Fairchild Aerial Surveys, Incorporated		Mar. 30, 1927	3,090.00	2,560.00	Feb. 17, 1928
11	Ashland Pipe Line	Ashland Res. to Res. No. 2, Gate Ho.	So. Sudbury	Antonio Mogavero	June 3, 1927	June 3, 1927	125,150.00	130,145.35	Sept. 24, 1928
12	Shafts 2, 3 & 4	Holden & Rutland	Ware	Dravo Contracting Company	May 20, 1927	May 24, 1927	259,800.00	632,727.44*	June 12, 1928
13	Whitehall Pipe Line	Whitehall Res. to City Road	So. Sudbury	Portland Contracting Company, Incorporated	July 15, 1927	July 15, 1927	54,963.00	60,603.17	June 12, 1928
15	Electric Power	Cordaville Pumping Station	So. Sudbury	Marlborough Electric Company		Aug. 4, 1927		** 270.09	June 1, 1928
16	Whitehall Open Channel	City Road to Hopkinton Res.	So. Sudbury	Sanders Engineering Company	Sept. 23, 1927	Sept. 23, 1927	36,720.00	32,695.16	July 9, 1928

*This amount includes construction beyond that which was contemplated when proposal was made.
**The Metropolitan District Commission has paid all bills for this contract subsequent to June 1, 1928.

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION

STATUS OF CONTRACTS IN FORCE BETWEEN NOV. 30, 1928 & NOV. 30, 1929

CONT. NO.	DESCRIPTION	LOCATION	SUPPLY	CONTRACTOR	BIDS OPENED	CONTRACT AWARDED	BASIS OF AWARD	PAYMENTS TO DATE
10	Transmission Line for Construction of Wachusett-Coldbrook Tunnel.	Tunnel Line	Ware	New England Power Company		Apr. 27, 1927	Maintenance at Cost.....	$17,607.32
							Construction at Cost.....	*86,439.58
14	East Portion Wachusett-Coldbrook Tunnel.	West Boylston, Holden & Rutland	Ware	West Construction Co.,(Assignee)	Nov. 18, 1927	Apr. 30, 1928	$4,074,981.25 **	1,649,160.71
17	West Portion Wachusett-Coldbrook Tunnel.	Rutland Oakham & Barre	Ware	West Construction Co.,(Assignee)	Nov. 18, 1927	Apr. 30, 1928	4,799,362.50 ***	2,392,237.47
18	Iron Castings for Ware River Intake Works.	Barre	Ware	Barbour Stockwell Co.	Jan. 4, 1929	Jan. 8, 1929	18,697.83	13,039.85
19	Dam and Substructure of Intake Building.	Barre	Ware	J.W. Bishop Co.	July 16, 1929	July 23, 1929	273,077.00	95,394.07
22	Unwatering Pump at Shaft 1.	West Boylston	Ware	F.A. Mazzur Co, Inc.	Nov. 5, 1929	Nov. 12, 1929	11,975.00	
23	Making Borings.	Belchertown, Ware, Enfield, Greenwich & Hardwick.	Swift	Sprague & Henwood, Inc.	Nov. 5, 1929	Nov. 5, 1929	10,950.00	

*This is the final estimate figure for the, "Construction at Cost," portion of Contract 10.
**Portion of work completed under Contract 12 before Contract 14 was executed reduces this amount by about 7.%
***Portion of work completed under Contracts 4 & 8 before Contract 17 was executed reduces this amount by about 7.%

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION

TOTAL VALUE OF WORK ACCOMPLISHED UNDER CONTRACTS IN PROGRESS DURING YEAR ENDING NOV. 30, 1929, - SHOWN MONTHLY

CONTRACT NUMBER	(10)	(14)	(17)	(18)	(19)	(22)	(23)
CONTRACTOR	New England Power Co.	West Const. Co.(Assignee)	West Const. Co.(Assignee)	Barbour Stockwell Co.	J.W. Bishop Co.	F.A. Mazzur Co., Inc.	Sprague & Henwood, Inc.
BASIS OF AWARD	Operation and maintenance at cost	$4,074,981.25 *	$4,799,362.52 **	$ 18,697.83	$ 273,077.00	$ 11,975.00	$ 10,950.00
DECEMBER 1928	$11,720.93	$388,635.08	$638,221.64				
JANUARY 1929	12,334.07	504,649.14	791,497.38				
FEBRUARY	13,012.87	628,143.34	980,917.76				
MARCH	13,701.74	749,898.40	1,158,224.76				
APRIL	14,363.58	876,825.87	1,354,233.76				
MAY	15,015.47	1,013,557.57	1,556,141.45	$1,610.97			
JUNE	15,769.36	1,167,081.87	1,768,191.45	3,653.54			
JULY	16,496.05	1,300,457.77	1,970,047.45	4,960.57			
AUGUST	17,190.51	1,433,549.20	2,170,144.45	5,907.16	$1,400.81		
SEPTEMBER	17,939.31	1,557,512.24	2,371,256.14	8,855.75	16,602.26		
OCTOBER	18,887.54	1,684,822.84	2,534,884.37	11,221.39	60,706.71		
NOVEMBER	19,563.69	1,832,400.79	2,658,041.63	14,488.72	105,993.41		

Total to first of previous month.

*Portion of work completed under contract 12 before contract 14 was executed reduces this amount by about 7%.
**Portion of work completed under contracts 4 and 8 before contract 17 was executed reduces this amount by about 7.%

CANVASS OF BIDS FOR CONTRACT 18, OPENED JANUARY 4, 1929.

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
CONTRACT 18
FURNISHING IRON CASTINGS FOR THE WARE RIVER INTAKE WORKS OF THE WACHUSETT-COLDBROOK TUNNEL IN THE TOWN OF BARRE.

ITEM	DESCRIPTION	UNIT	QUANTITY	① THE ALDRICH PUMP CO. Front St. Allentown, Pa.		* ② BARBOUR STOCKWELL CO. 205 Broadway Cambridge, Mass.		③ GIBBY FOUNDRY CO. 96 Condor St. East Boston, Mass.		④ WEATHERLY FOUNDRY & MFG. CO. Weatherly, Pa.		⑤ BUILDERS IRON FOUNDRY Providence, R.I.	
				PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT
1	Shaft lining plates	Ton	243	58.90	14,312.70	63.70	15,479.10	70.00	17,010.00	80.00	19,440.00	77.40	18,808.20
2	Nozzle castings for shaft valves	Ton	23.4	122.00	2,854.80	77.90	1,822.86	120.00	2,808.00	148.50	3,474.90	238.80	5,587.92
3	Base castings for shaft valves	Ton	11.9	98.00	1,166.20	117.30	1,395.87	150.00	1,785.00	114.40	1,361.36	134.40	1,599.36
					18,333.70		18,697.83		21,603.00		24,276.26		25,995.48

ITEM	DESCRIPTION	UNIT	QUANTITY	⑥ KUTZTOWN FOUNDRY & MACHINE CO. 1421 Chestnut St. Philadelphia, Pa.		⑦ HARRISON SQUARE FOUNDRY CO. 110 Gibson St. Dorchester, Mass.		⑧ HOLYOKE MACHINE CO. 81 Thomas St. Worcester, Mass.		⑨ U.S. CAST IRON PIPE & FOUNDRY CO 1421 Chestnut St. Philadelphia, Pa.			
				PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT		
1	Shaft lining plates	Ton	243	82.00	19,926.00	110.00	26,730.00	120.00	29,160.00				
2	Nozzle castings for shaft valves	Ton	23.4	187.00	4,375.80	120.00	2,808.00	200.00	4,680.00				
3	Base castings for shaft valves	Ton	11.9	175.00	2,082.50	100.00	1,190.00	240.00	2,856.00				
					26,384.30		30,728.00		36,696.00		45,485.00		

INFORMAL LUMP SUM BID

* Contract awarded to Barbour Stockwell Co. Jan. 8, 1929.

CANVASS OF BIDS FOR CONTRACT No. 19, OPENED JULY 16, 1929.

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
CONTRACT No. 19, FOR CONSTRUCTING THE DAM AND SUBSTRUCTURE OF THE INTAKE BUILDING FOR THE WARE RIVER INTAKE WORKS AT SHAFT 8 OF THE WACHUSETT-COLDBROOK TUNNEL IN THE TOWN OF BARRE.

ITEM	DESCRIPTION	UNIT	QUANTITY	* (1) J.W. BISHOP CO. 109 FOSTER ST., WORCESTER, MASS.		(2) THE TULLER CONSTRUCTION CO. 95 MONMOUTH ST., RED BANK, N. J.		(3) MONROE & WESTCOTT INC. COMMUNITY THEATER BLDG. NO ATTLEBORO. MASS.		(4) THE MILTON CONSTRUCTION & ENGRG. CORP. 141 MILK ST., BOSTON. MASS.		(5) WINSTON & CO INC. 277 FAIR ST., KINGSTON, N.Y.		(6) CENEDELLA & CO. 68 SCHOOL ST., MILFORD, MASS.		(7) JAMES J. COUGHLAN & SONS INC. 27 SCHOOL ST., BOSTON. MASS.	
				PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT
1	Clearing.	Acre.	5	95.00	$ 475.00	200.00	$ 1,000.00	200.00	$ 1,000.00	200.00	$ 1,000.00	90.00	$ 450.00	150.00	$ 750.00	150.00	$ 750.00
2.	Grubbing.	Acre.	3	220.00	660.00	400.00	1,200.00	300.00	900.00	300.00	900.00	250.00	750.00	300.00	900.00	150.00	450.00
3.	Earth Excav. (below El. 642.)	Cu. Yd.	5,000	1.85	9,250.00	2.00	10,000.00	3.00	15,000.00	5.00	25,000.00	3.00	15,000.00	6.00	30,000.00	7.50	37,500.00
4.	Earth Excav. (above El. 642.)	Cu. Yd.	4,000	1.20	4,800.00	1.25	5,000.00	2.00	8,000.00	3.00	12,000.00	1.50	6,000.00	1.50	6,000.00	6.50	26,000.00
5.	Dock Excav.	Cu. Yd.	700	6.00	4,200.00	12.00	8,400.00	10.00	7,000.00	6.00	4,200.00	5.00	3,500.00	8.00	5,600.00	12.00	8,400.00
6	Diver Control.	Lump Sum			11,300.00		9,000.00		13,000.00		3,300.00		15,000.00		12,000.00		5,000.00
7.	B & A.R.R. Culvert. (in addition to other items)	Lump Sum			3,412.00		1,000.00		1,500.00		1,000.00		2,000.00		1,500.00		1,000.00
8	Refill & Embanking (Imperv. Mat'l)	Cu. Yd	500	1.50	750.00	1.50	750.00	1.00	500.00	1.00	500.00	1.50	750.00	1.75	875.00	1.50	750.00
9	Refill & Embanking (Perv. Mat'l)	Cu Yd	9,000	.90	8,100.00	.75	6,750.00	.60	5,400.00	.50	4,500.00	.90	8,100.00	1.00	9,000.00	1.50	13,500.00
10	Surface Dressing of Top Soil	Cu. Yd	100	3.00	300.00	2.00	200.00	2.00	200.00	1.00	100.00	1.50	150.00	2.50	250.00	3.00	300.00
11	Seeding & Grassing (if required)	Lump Sum			170.00		60.00		100.00		100.00		100.00		800.00		1,000.00
12.	Riprap	Cu Yd	4,000	2.00	8,000.00	1.00	4,000.00	2.00	8,000.00	5.25	21,000.00	3.00	12,000.00	2.00	8,000.00	3.00	12,000.00
13.	Paving.	Cu. Yd.	250	4.00	1,000.00	3.00	750.00	4.00	1,000.00	5.00	1,250.00	5.00	1,250.00	5.00	1,250.00	10.00	2,500.00
14	Crushed Stone, Gravel & Sand	Cu Yd	100	3.50	350.00	5.00	500.00	4.00	400.00	3.50	350.00	4.00	400.00	2.50	250.00	5.00	500.00
15.	Portland Cement.	Barrel	11,000	2.75	30,250.00	3.50	38,500.00	3.50	38,500.00	2.65	29,150.00	2.50	27,500.00	2.75	30,250.00	2.70	29,700.00
16.	Concrete Masonry, Class "A".	Cu. Yd	3,300	12.00	39,600.00	20.00	66,000.00	15.00	49,500.00	12.69	41,877.00	22.00	72,600.00	19.00	62,700.00	17.00	56,100.00
17.	Concrete Masonry. Class "B"	Cu. Yd.	2,900	12.00	34,800.00	11.00	31,900.00	12.00	34,800.00	11.00	31,900.00	16.00	46,400.00	11.00	31,900.00	16.00	46,400.00
18.	Dimension Stone Masonry	Cu. Yd.	100	165.00	16,500.00	126.00	12,600.00	140.00	14,000.00	165.00	16,500.00	100.00	10,000.00	160.00	16,000.00	170.00	17,000.00
19.	Ashlar Masonry	Cu. Yd.	550	65.00	35,750.00	65.00	35,750.00	60.00	33,000.00	70.00	38,500.00	60.00	33,000.00	67.00	36,850.00	84.00	46,200.00
20.	Brick Masonry (for C.B., M.H. & Cesspool.)	Cu. Yd.	30	31.00	930.00	40.00	1,200.00	40.00	1,200.00	35.00	1,050.00	40.00	1,200.00	40.00	1,200.00	30.00	900.00
21.	Hollow Terra Cotta in bldg partitions.	Cu Yd	5	31.00	155.00	35.00	175.00	50.00	250.00	20.00	100.00	30.00	150.00	22.00	110.00	30.00	150.00
22.	Granolithic Finish	Sq Yd	600	.75	450.00	1.50	900.00	1.50	900.00	.63	378.00	1.00	600.00	2.00	1,200.00	1.50	900.00
23	Grout.	Cu. Yd	200	8.00	1,600.00	5.00	1,000.00	8.00	1,600.00	7.00	1,400.00	10.00	2,000.00	16.00	3,200.00	10.00	2,000.00
24	Drilling holes in rock & masonry	Lin. Ft	400	1.15	460.00	2.25	900.00	1.00	400.00	1.00	400.00	1.50	600.00	.75	300.00	.50	200.00
25	Steel for reinforcing concrete	Pound.	260,000	.04½	11,700.00	.05	13,000.00	.05	13,000.00	.05	13,000.00	.06	15,600.00	.05½	14,300.00	.06	15,600.00
26	Timber and Lumber.	M Feet B.M.	50	107.00	5,350.00	120.00	6,000.00	100.00	5,000.00	100.00	5,000.00	100.00	5,000.00	120.00	6,000.00	125.00	6,250.00
27	Doors.	Lump Sum.			490.00		300.00		300.00		270.00		400.00		600.00		1,000.00
28	C.I. Pipe & Spec. Castings, (flanged)	Pound	50,000	.12	6,000.00	.08	4,000.00	.10	5,000.00	.14	7,000.00	.08	4,000.00	.10	5,000.00	.11	5,500.00
29	C.I. Pipe & Spec Castings, (b & s)	Pound	7,500	.06	450.00	.07	525.00	.10	750.00	.14	1,050.00	.04	300.00	.07	525.00	.138	1,035.00
30	Galv. steel pipe & fittings, 6 inch.	Lin Ft	100	9.00	900.00	2.00	200.00	9.00	900.00	2.00	200.00	4.00	400.00	2.00	200.00	12.32	1,232.00
31.	Galv. steel pipe & fittings, 10 inch.	Lin. Ft.	200	12.00	2,400.00	3.00	600.00	10.00	2,000.00	4.00	800.00	6.00	1,200.00	3.00	600.00	18.70	3,740.00
32	Brass pipe and fittings	Pound	4,000	.52	2,080.00	.50	2,000.00	.50	2,000.00	.50	2,000.00	.60	2,400.00	.60	2,400.00	.94	3,760.00
33	Vitrified sewer pipe, 8" to 12" inc	Lin Ft.	250	1.20	300.00	.80	200.00	1.00	250.00	1.50	375.00	1.00	250.00	1.50	375.00	1.00	250.00
34.	Coring for & setting valve bases, etc.	Pound	150,000	01½	1,875.00	.01	1,500.00	02½	3,750.00	.03	4,500.00	.03	4,500.00	.05	7,500.00	.03	4,500.00
35.	Installing Oil Pressure System.	Lump Sum.			700.00		400.00		200.00		1,000.00		1,500.00		900.00		450.00
36.	Coring for & Inst'l Vacuum Prim. App.	Lump Sum.			600.00		500.00		200.00		550.00		500.00		800.00		600.00
37.	Coring for & inst. other Metal Work.	Pound	15,000	02	300.00	.01	150.00	03	450.00	04	600.00	.04	600.00	04	600.00	.03	450.00
38.	Electric Wiring	Lump Sum			1,000.00		1,000.00		600.00		1,200.00		500.00		600.00		1,850.00
39	Plumbing	Lump Sum.			1,700.00		2,500.00		800.00		1,300.00		600.00		1,100.00		1,500.00
40.	Heating	Lump Sum.			4,520.00		3,500.00		4,500.00		4,500.00		2,800.00		4,700.00		5,000.00
41.	Automatic Shutters	Lump Sum.			500.00		500.00		500.00		480.00		100.00		700.00		610.00
42.	Trash Racks.	Pound.	35,000	.09	3,150.00	.07	2,450.00	.08	2,800.00	.12	4,200.00	.12	4,200.00	.15	5,250.00	13	4,550.00
43.	Misc C.I., W.I., & Steel.	Pound.	75,000	.14	10,500.00	.10	7,500.00	.13	9,750.00	.12	9,000.00	.15	11,250.00	.12	9,000.00	32½	24,375.00
44.	Galvanizing	Pound.	30,000	.05	1,500.00	.01	300.00	.05	1,500.00	.06	1,800.00	.04	1,200.00	.07	2,100.00	.06	1,800.00
45	Misc. brass, bronze & copper.	Pound.	600	1.00	600.00	.50	300.00	1.00	600.00	.50	300.00	.70	420.00	.75	450.00	1.10	660.00
46	Demol'g Pem White Valley Dam, etc.	Lump Sum.			1,500.00		500.00		1,000.00		1,000.00		1,000.00		600.00		1,000.00
47.	Cleaning up.	Lump Sum.			1,700.00		1,000.00		1,000.00		1,000.00		1,000.00		1,000.00		1,500.00
	TOTALS				$ 273,077.00		$ 286,460.00		$ 293,000.00		$ 297,580.00		$ 319,220.00		$ 326,185.00		$ 396,412.00

* CONTRACT AWARDED TO J.W. BISHOP CO. JULY 23, 1929.

CANVASS OF BIDS FOR CONTRACT 22 OPENED NOV. 5, 1929.

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
CONTRACT 22
FURNISHING AND INSTALLING AN UNWATERING PUMP IN SHAFT 1 OF THE WACHUSETT-COLDBROOK TUNNEL IN THE TOWN OF WEST BOYLSTON.

NAME	PUMP	MOTOR	COST	REMARKS
★F.A. Mazzur Co., Inc. 141 Milk St. Boston, Mass.	Warren Steam Pump Co.	General Electric	$11,975.00	Alternate: $500 to be deducted for Westinghouse instead of General Electric motor but without water tightness specified for motor casing.
Allis-Chalmers Mfg. Co. Milwaukee, Wis.	Allis-Chalmers	Allis-Chalmers	$14,300.00	
Turbine Equipment Co. of New England 80 Federal St. Boston, Mass.	De Laval Steam Turbine Co.	General Electric	$14,795.00	Alternates: $1330 and $1795 respectively to be deducted for 2 couplings not of stainless steel as specified.

★ Contract awarded to F.A. Mazzur Co., Inc. Nov. 12, 1929.

Canvass of Bids for Contract 23 Opened November 5, 1929.

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
CONTRACT 23
FOR MAKING BORINGS IN THE TOWNS OF BELCHERTOWN, ENFIELD, WARE, GREENWICH AND HARDWICK.

ITEM	DESCRIPTION	UNIT	QUANTITY	★ (1) Sprague & Henwood Inc. Scranton, Pa. PRICE	AMOUNT	(2) Gray-Milaeger Drilling Co 123 Wisconsin Ave., Milwaukee, Wis. PRICE	AMOUNT	(3) The Giles Drilling Corporation 19 W. 44th St., New York, N.Y. PRICE	AMOUNT
1.	Wash borings	Lin. Ft.	300	2.45	735.00	3.00	900.00	2.75	825.00
2.	Core borings to surface of sound bed rock	Lin. Ft.	2,500	3.25	8,125.00	3.00	7,500.00	3.65	9,125.00
3.	Core borings in sound bed rock	Lin. Ft.	600	3.25	1,950.00	5.00	3,000.00	3.65	2,190.00
4.	Casing ordered left in place	Lin. Ft.	200	0.70	140.00	1.00	200.00	0.75	150.00
					$10,950.00		$11,600.00		$12,290.00

ITEM	DESCRIPTION	UNIT	QUANTITY	(4) Riley Drilling Co. 280 Broadway New York, N.Y. PRICE	AMOUNT	(5) Pennsylvania Drilling Company 1812 West Carson St. Pittsburgh, Pa. PRICE	AMOUNT	(6) Kennedy-Riegger Drilling Co. Inc. 30 Church St. New York, N.Y. PRICE	AMOUNT
1.	Wash borings	Lin. Ft	300	2.50	750.00	4.00	1,200.00	6.50	1,950.00
2.	Core borings to surface of sound bed rock	Lin. Ft.	2,500	3.75	9,375.00	4.15	10,375.00	6.50	16,250.00
3.	Core borings in sound bed rock.	Lin Ft	600	4.00	2,400.00	4.90	2,940.00	6.50	3,900.00
4.	Casing ordered left in place	Lin. Ft.	200	1.00	200.00	0.80	160.00	1.14	228.00
					$12,725.00		$14,675.00		$22,328.00

★ Contract awarded to Sprague & Henwood Inc. Nov. 5, 1929.